

Sci Bibl

SCIENCE

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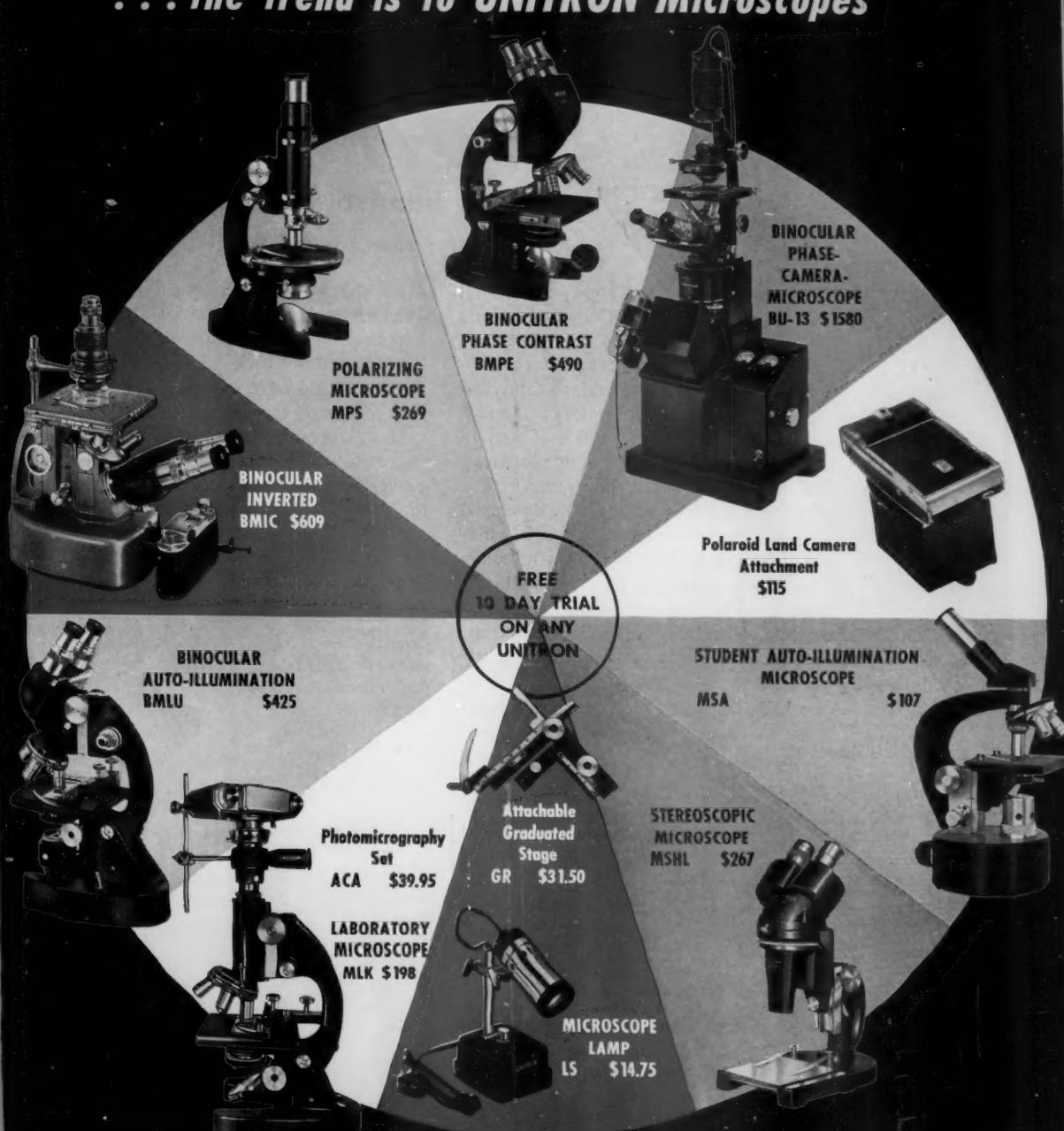
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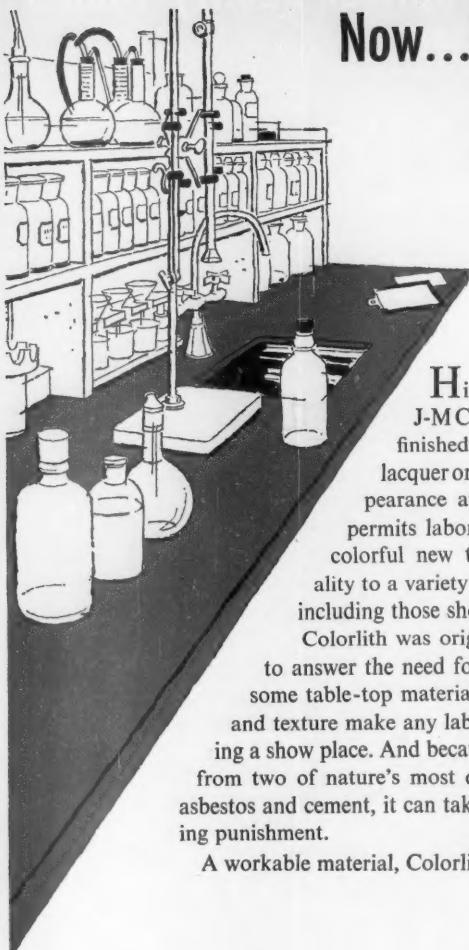
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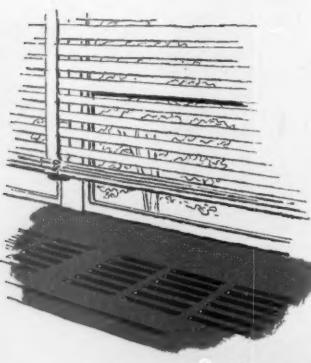
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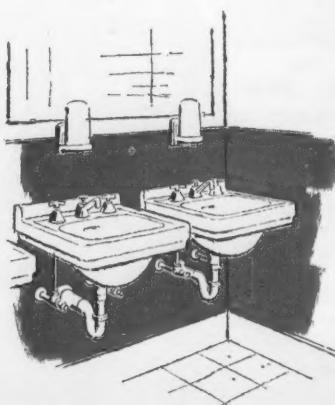
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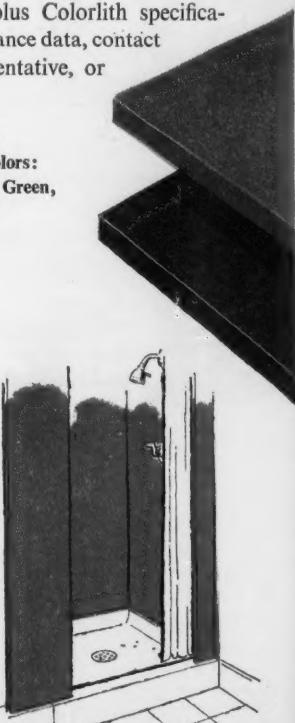
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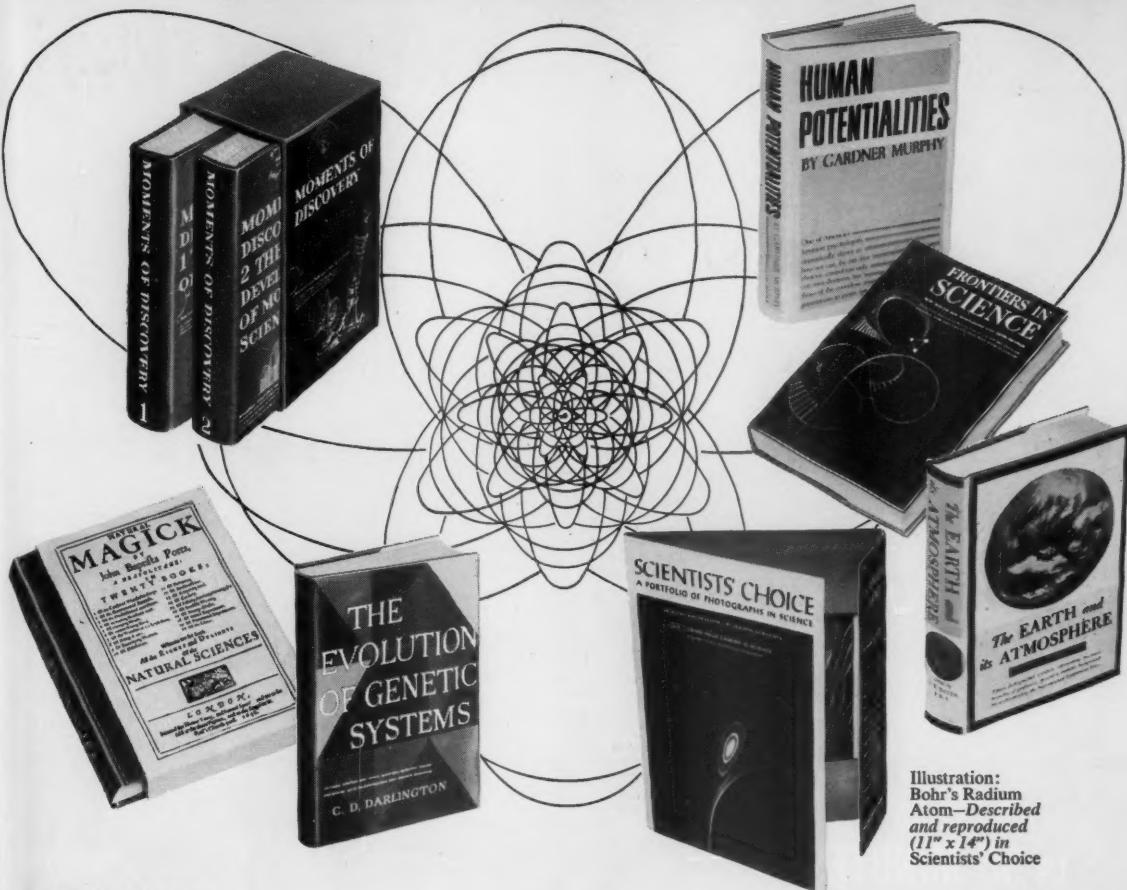


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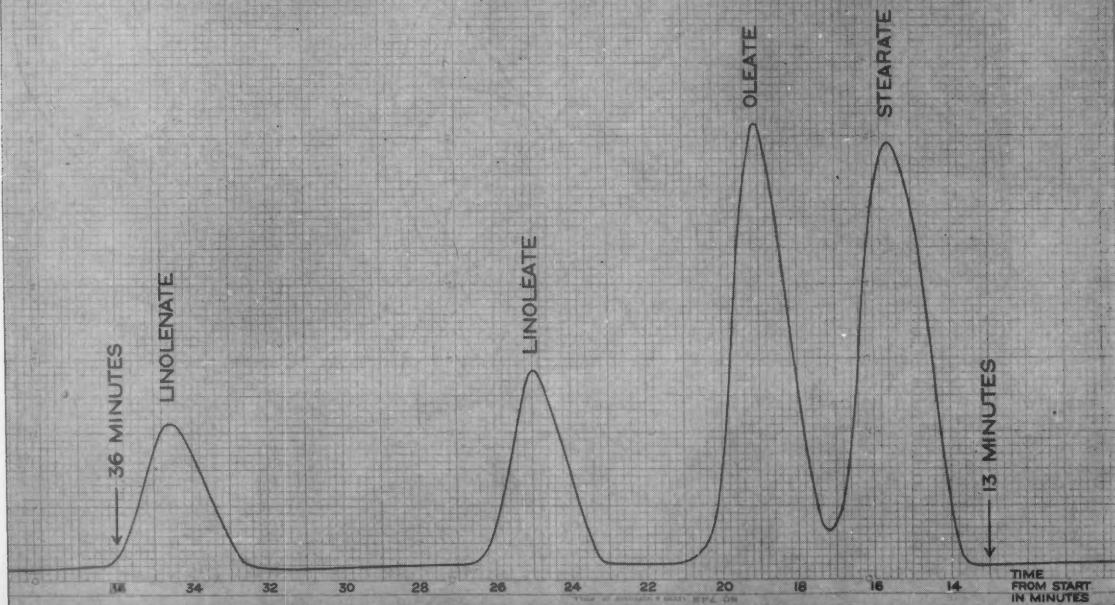
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*Hausdorff, H. H. and Brenner, N., "Gas Chromatography—Powerful New Tool for Chemical Analysis." *Oil and Gas Journal*, editions of June 30, July 14, July 21 and August 4, 1958.

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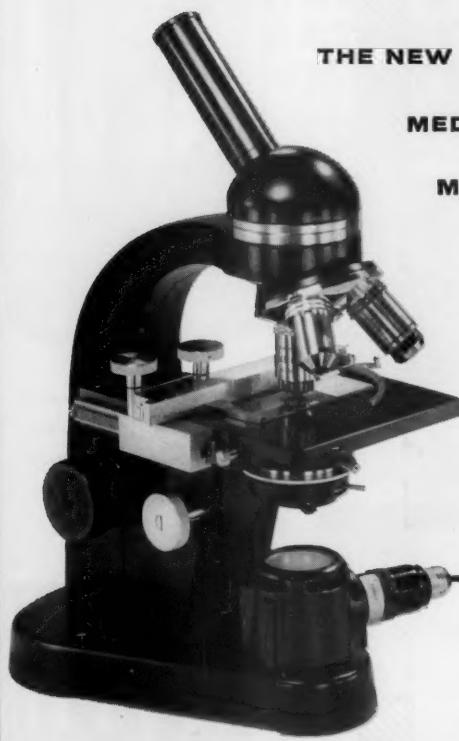
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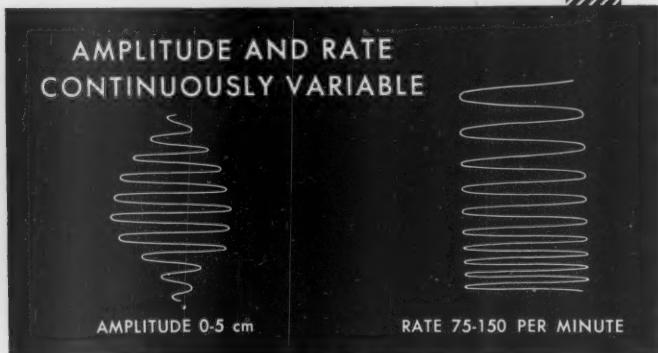
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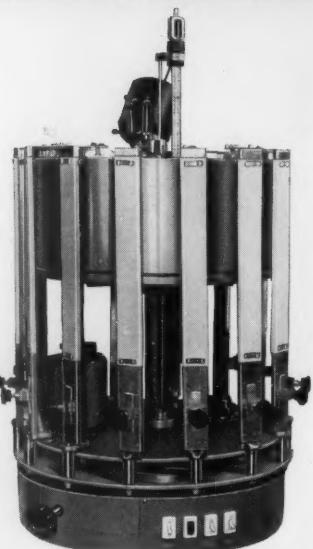
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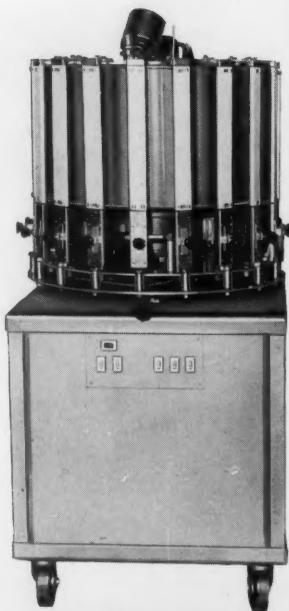
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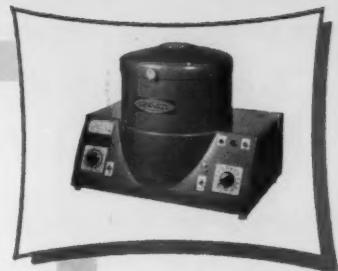
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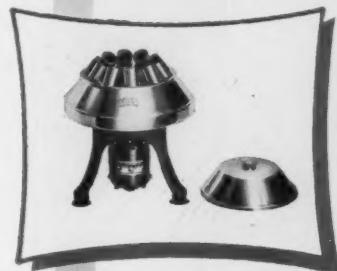
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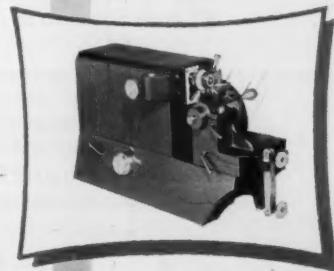
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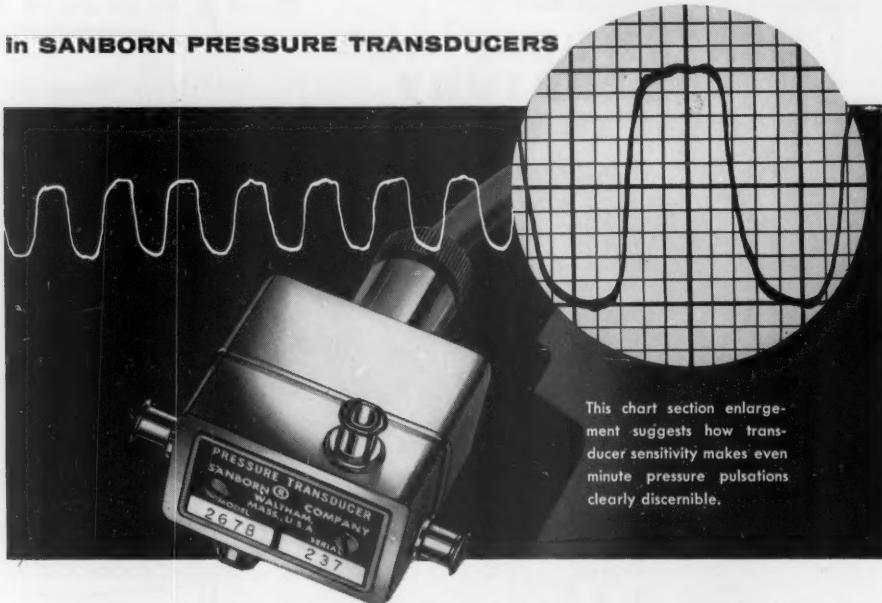


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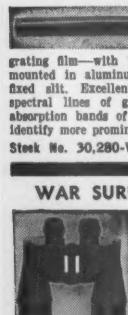
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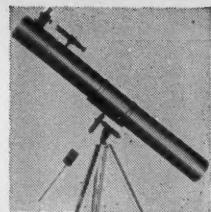
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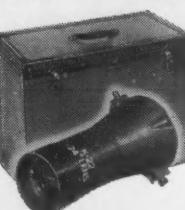
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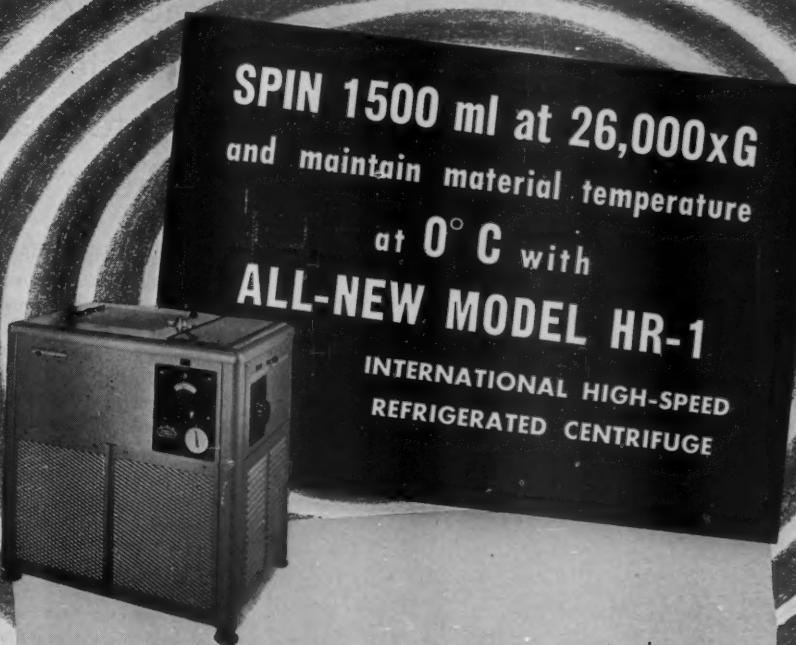
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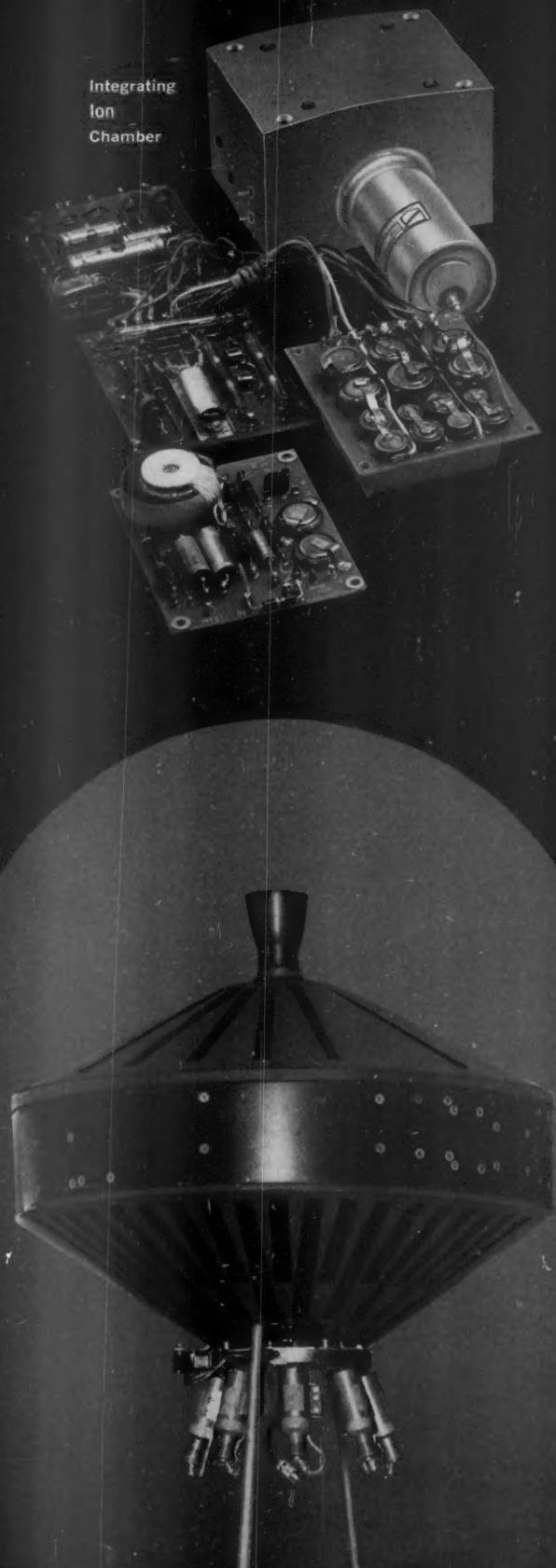
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Washington, D.C., December 26-31, 1958

The list of hotels and their rates and the reservation coupon below are for your convenience in making your hotel room reservation in Washington. Please send your application, *not* to any hotel directly, but to the AAAS Housing Bureau in Washington and thereby avoid delay and confusion. The experienced Housing Bureau will make assignments promptly; a confirmation will be sent you in two weeks or less.

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*Shoreham	all 9.00	all 12.00	all 12.00	20.00-50.00
*Statler	all 10.00	all 14.00	all 14.00	24.00-30.00
*Washington	7.00- 8.00	11.00-12.50	11.00-12.50	24.50-45.00
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Roosevelt	7.00- 9.00		10.00-12.00	18.00-24.00
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of the General Program-Directory of the AAAS Washington Meeting

by first class mail — early in December

The General Program-Directory of the 125th Meeting of the AAAS in Washington, D.C., Dec. 26-31, 1958, will be available to anyone, at cost, within the first week in December—whether he can attend the Meeting or not. You will want the General Program-Directory for your reference shelf.

Program content

1. The two-session general symposium, "Moving Frontiers of Science III: The Structure of Science and Scientific Organizations Abroad," arranged by the Committee on AAAS Meetings.
2. The six sessions of the Conference on Scientific Communication Problems.
3. Programs of the 18 AAAS sections (symposia and contributed papers).
4. Programs of the more than 90 participating societies.
5. The Special Sessions: AAAS, Academy Conference, Conference on Scientific Manpower, National Geographic Society, Phi Beta Kappa, Sigma Xi, RESA.
6. Details of the Sheraton-Park Hotel—center of the Meeting—and of the other hotels and session sites.
7. Titles of the latest foreign and domestic scientific films to be shown in the AAAS Science Theatre.
8. Exhibitors in the 1958 Annual Exposition of Science and Industry and descriptions of their exhibits.

Directory content

1. AAAS officers, staff, committees for 1958.
2. Complete roll of AAAS presidents and their fields.
3. The 279 affiliated organizations.
4. Historical sketch and organization of the Association; the Constitution and Bylaws.
5. Publications of the Association.
6. AAAS Awards—including all past winners.
7. Membership figures by sections.
8. Section committees (Council members) in detail.
9. Local committees.
10. Future Meetings of the AAAS through 1962.
11. New and current activities of the AAAS.

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Letters

International Language

Some inadequate and inaccurate information concerning Esperanto and Interlingua seems to have come to Mario Pei for inclusion in his book *One Language for the World and How to Achieve It*. Alexander Gode's review of the book in *Science* [128, 194 (1958)] adds a little more.

Pei gives considerable and generally favorable attention to Esperanto, but he is content with 1952 figures about it. He cites the absurd charge that early Esperanto congresses "frequently broke up in confusion, with schismatic movements arising from them," and remarks that "the difference between Esperanto and its many schismatic descendants may be described as trifling, but it is useless to deny that they weaken the movement for an international language by dispersing the energies of the interlinguists" (p. 164). He seems to hold Esperanto itself responsible for its would-be reformers and competitors.

This is not altogether fair. If the body of Esperantists had compromised with the individuals or groups seeking to modify the language and had accepted their changes, however "trifling," or had heeded the advice of bystanders that they "get together" with the advocates of unlike systems, Esperanto would have become as fluid as some of its competitors and would soon have perished. Its "lack of stability" would then have become an argument for proving any constructed language chimerical and futile. The Congress of International Associations, which in 1920 endorsed Esperanto as a world auxiliary language, had the wisdom to recommend that any improvement in it be deferred until it be adopted by the governments (p. 213). Of course the emergence of new linguistic systems weakened the Esperanto movement and lessened the impact of its actual demonstration of the practicability of the auxiliary language idea. The same thing is happening today, in the attempt to promote the inferior rival system Interlingua.

Apparently, Pei is quite interested in Interlingua, the only interlanguage produced by persons hired to do so. Its history, as he has it, is like a fairy tale: "Almost twenty years ago, a group of linguists, heavily financed by a very wealthy lady, undertook to construct an international language on a truly 'scientific' basis" (p. 171). The facts behind the fairy tale are as follows: Mrs. Alice Vanderbilt Morris became interested in Esperanto as a possible addition to her philanthropies. But the idea of forming an organization to sponsor impartial examination of the whole subject of inter-

language was presented to her at this time. Dropping the thought of Esperanto, Mrs. Morris (aided by her husband, Dave Hennen Morris) organized an International Auxiliary Language Association (IALA), which was incorporated in 1924 with an impressive board of directors. Its "Outline of Program" stated that its function was "merely to serve as a neutral clearing-house for study and information," with "no intention of developing or promoting any new language."

After about a decade, the IALA stopped sponsoring impartial research and undertook the creation of a language. It assembled a staff, three directors of research being successively employed, with some overlapping in different capacities at one time or another, some delay and part-time employment, especially in the war years, and some time out for preparation of a series of foreign-language textbooks. The first director was E. Clark Stillman, who left in 1942. The second was André Martinet, from 1946 to 1948. The third was Alexander Gode, already on the staff, who "assumed full direction of the work" in 1948 and was responsible for it thereafter (Interlingua dictionary, *Storm Publishers*, New York, 1951, pp. xiii–xiv).

The statement Pei imputes to Gode, describing Interlingua as "the product of the world's greatest linguistic minds over a period of nearly thirty years" (p. 238), must refer to these three men (Stillman, Martinet, Gode); and the "period of nearly thirty years" must mean the IALA's life span (1924–1953), regardless of the fact that during the first decade thereof the IALA was not producing a language and sponsored very few projects or studies having any bearing on language creation. The statement in the IALA circular *Practical World Language* that "work on the dictionary was begun at the University of Liverpool under Professor William E. Collinson," and the further inaccurate implication to the same effect in the foreword to the Interlingua dictionary (p. xiii) surprised a number of persons, including Collinson himself, an active supporter of Esperanto, whose commission executed for the IALA may have been the last it offered any scholar during its impartial research period.

The "scientific basis" claimed for Interlingua, as in the sentence quoted at the beginning of the foregoing paragraph, seems exaggerated. Fewer source languages than are represented in Esperanto were used in the compilation of Interlingua's vocabulary (actually only Italian, Spanish, Portuguese, French, and English—its Romance element only). The Interlingua dictionary mentions adoption of "principles," such as that words considered for acceptance must

(Continued on page 1458)

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The basic mechanism

Particle Accelerators in Biological Research—III

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Accelerators Give Confidence

The early work on

Radiation Effects in the Gaseous Phase—IX

A study of the effects of ionizing radiation.

Radiation Effects on Microorganisms—X

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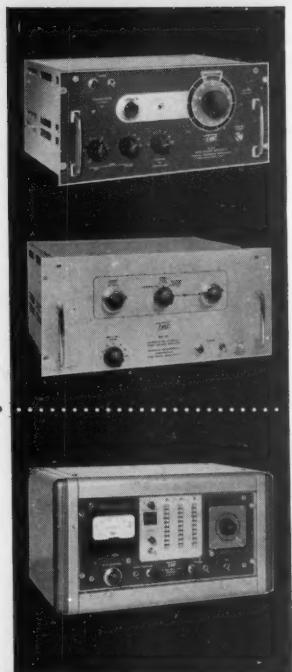
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A Scientific Smorgasbord

When thousands of local and visiting scientists and teachers convene in Washington for the 125th AAAS meeting, 26-31 December, approximately 300 sessions will provide a rich variety of short reports of current research, panels, symposia both specialized and interdisciplinary, and notable evening addresses. There also will be conferences, religious events, business sessions, tours, social functions, and the large-scale exhibits and Science Theatre. Since no one can occupy more than one point in space at any given moment, choices of what to attend each day must be made.

"Too many good programs at the same time" is a common remark, not without some validity. Concurrent attractions are an inevitable consequence of scheduling programs of the AAAS as a whole, of its 18 sections, and of some 50 societies, within five or six days, but virtually no one has the time or funds to stay for three weeks.

Fortunately, each program draws its own audience, many of whom will then attend other sessions and features that otherwise might not have brought them to the meeting. As in a restaurant, one must choose between fish, flesh, and fowl—or an exotic dish—on successive days. Or, on the same day, as at a smorgasbord, one may sample smaller portions of almost every dish.

The meeting is not unorganized. Within each discipline, concurrent sessions are at a minimum and general sessions are spread out. The Exposition and the Science Theatre have been scheduled so that they may be visited at any time between technical sessions. The Exposition is one of the largest and most varied in recent years, and the Science Theatre will present a selection—for the first time in this country—of recent prize-winning foreign films. Since the demonstrations of a new, improved closed-circuit color TV system, using a large screen, with teaching content, have been scheduled at 5 to 6 P.M., almost all will be able to attend.

The American Society of Zoologists has scheduled one four-session symposium, a second five-session symposium, eight sessions for contributed papers, a business meeting, and a dinner within three days, but it has been assumed that vertebrate zoologists, arthropod physiologists, ecologists, and taxonomists can be well accommodated by concurrent sessions. The two-session symposium, "Unsolved Problems in Biology III, 1958," sponsored by Sections F and G, will be held 30 December, after completion of the ASZ program, and therefore need not be missed.

The annual meeting of the American Astronautical Society, the three IGY sessions, the symposium of the American Physiological Society in space medicine, and a program of the Society for Industrial Microbiology have been fitted together so that space-minded scientists may attend all of them.

Among the religious events, the only time conflict is between Paul Tillich, guest speaker at the Washington Cathedral, and William J. McDonald, rector of the Catholic University of America. Phi Beta Kappa and the Society of the Sigma Xi have scheduled a joint address, to be given by James R. Killian, Jr. Among the unusually large number of speakers from abroad are Julian Huxley and Goeffrey Dawes. Graduate students and younger faculty members who may never have attended an AAAS meeting are particularly invited to come. Temperate indulgence in a smorgasbord need not be followed by indigestion, mental or other.—RAYMOND L. TAYLOR, AAAS

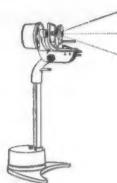
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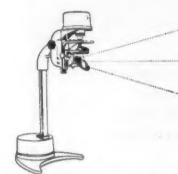
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The Brookhaven Alternating Gradient Synchrotron

Construction of a massive nuclear research machine requires ideas, men, and methods from many fields.

R. A. Beth and C. Lasky

A noteworthy characteristic of the evolution of physical science is the increasing degree of effort required to push back the frontiers of knowledge. A few centuries ago important fundamentals were elucidated by individuals, often working alone, and dealing with phenomena of man's order of size—say, a meter. Atomic nuclei are roughly 10^{14} times smaller, and galaxies are 10^{21} times larger. Modern particle accelerators and astronomical telescopes for studying phenomena at these extreme scales require years of planning, millions of dollars, hundreds of man-years, and elaborate ancillary experimental equipment. The resources required exceed the capacity of individuals or even of universities to provide—a far cry from the work of Galileo, Faraday, and Hertz. The new proton accelerator under construction at the Brookhaven National Laboratory is an outstanding example of the immense effort required for modern research at the very small size scale of nuclear phenomena.

Brookhaven National Laboratory

The Brookhaven National Laboratory was created after World War II, on the site of the Army's old Camp Upton, by Associated Universities, Incorporated, an organization established by Columbia, Cornell, Harvard, Johns Hopkins, Massachusetts Institute of Technology, Penn-

sylvania, Princeton, Rochester, and Yale for the pursuit of large research projects. Brookhaven National Laboratory is operated by Associated Universities, Incorporated, for the U.S. Atomic Energy Commission for research in physics, chemistry, biology, medicine, and related fields. The laboratory lies about 70 miles east of New York City, just over halfway out toward the eastern tip of Long Island. Here was built the world's first multibillion-volt accelerator, the cosmotron, completed in 1952, which is capable of producing 3-Bev protons. Cosmotron research has already contributed greatly to man's knowledge of elementary particles and high-energy physics.

Alternating Gradient Synchrotron

The construction of a still larger accelerator for production of proton energies approaching ten times those of the cosmotron is now under way at Brookhaven. This accelerator will be the world's largest when it is completed in 1960.

The use of the new alternating gradient "strong focusing" principle (1) permits the construction of such a high-energy machine with relatively much less magnet steel than would be needed with the older "weak focusing" designs. Thus, the Brookhaven alternating gradient synchrotron, or AGS, will require about 4000 tons of steel to produce protons of

over 25-Bev energy, while the largest existing machines (the synchrophasotron in the U.S.S.R. and the bevatron in California) have used, respectively, 36,000 and 10,000 tons for the production of 10- and 6.2-Bev protons. The cosmotron has about 2000 tons of magnet steel.

The Brookhaven AGS is somewhat larger than the similar alternating gradient synchrotron being built simultaneously near Geneva, Switzerland, by the 12-nation European Organization for Nuclear Research (CERN) and scheduled for completion shortly before our synchrotron. A project to construct a 50-Bev alternating gradient machine has recently been announced in the U.S.S.R.

An over-all plan of the Brookhaven AGS complex is shown in Fig. 1 (north is toward the top of Fig. 1), while Fig. 2 is an aerial view, looking southward, of the state of construction in May 1957. The size of the synchrotron ring may be compared with that of the large flat-roofed building (at the upper right of the AGS ring in Fig. 2) which houses the cosmotron, and with the Brookhaven research reactor (pile) at the upper left; a diffusion basin for AGS magnet cooling water is shown at the lower left.

Figure 3 shows the magnet tunnel during construction. The opening is about 18 feet square, and the ring is $\frac{1}{2}$ mile in circumference. The inward projections in the upper part of the tunnel support the rails of two 20-ton traveling cranes that span the tunnel for handling the magnets and other equipment. The tunnel is now covered with earth, for radiation shielding and to aid the air-conditioning system in keeping the interior temperature constant to $\pm 2^{\circ}\text{F}$.

Injection

The operation of the alternating gradient synchrotron may be described by following the protons from source to target in Fig. 1.

Protons are the nuclei of the most common isotope of hydrogen. Hydrogen gas is supplied to a cold cathode dis-

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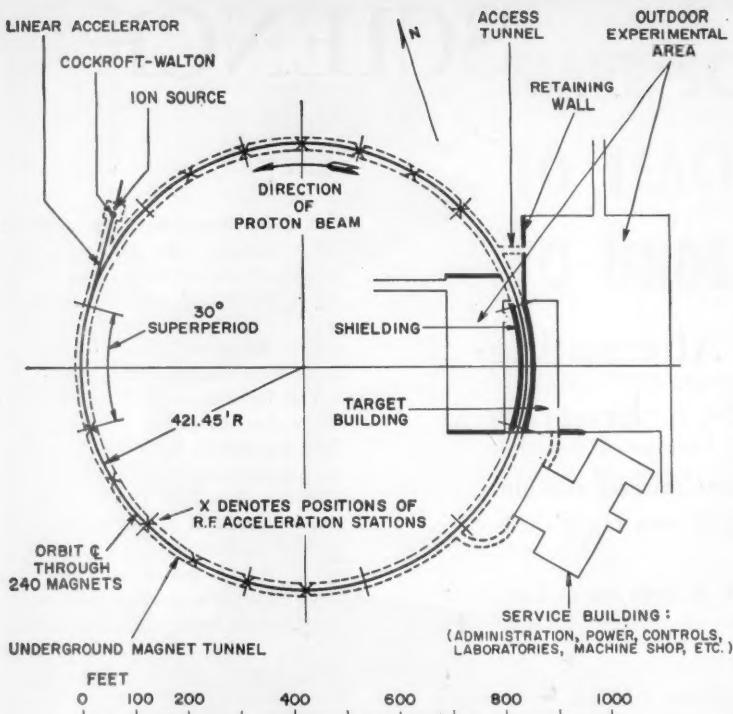


Fig. 1. Plan of the Brookhaven alternating gradient synchrotron.

charge at a pressure of about 1/20,000 of an atmosphere in the ion source shown at the upper left of Fig. 1. Protons from the ionized gas in the discharge pass through a small orifice 1 or 2 millimeters in diameter in the cathode, whereupon they are accelerated through 750 kilovolts by a Cockcroft-Walton generator.

The 750-kev protons are then accelerated to 50 million electron volts (Mev) in the linear accelerator, or "linac." In the linac, the protons pass through 124 drift tubes of varying length and diameter placed along the axis of a copper-lined tank about 1 meter in diameter and 110 feet long. Figure 4 shows an experimental model of a tank section with three drift tubes. The tank is both a vacuum enclosure and a cavity resonator which will be driven at 200 megacycles per second so that adjacent drift tubes will oscillate in opposite phase electrically.

The protons are "bunched" in the beam like beads on a string, and the spacing of bunches increases with velocity through the linac. Each bunch experiences a forward or accelerating electric field in the gap between drift tubes. While the bunch is passing at constant velocity through the axial hole within the drift tube, the cavity oscillation re-

verses the electrical polarity of the tubes so that the bunch is again subjected to an accelerating field by the time it reaches the next gap. By proper choice of the voltages, tube lengths, and spacings, bunches are accelerated simultaneously at alternate gaps all along the linac. The peak gap voltages vary from 116 kilovolts at the beginning to 890 kilovolts at the end, and the cavity requires 3 megawatts of power at 200 megacycles per second during the acceleration. The oval shaping of the drift tubes, as shown in Fig. 4, materially reduces the energy required to excite the electromagnetic oscillations within the cavity to given gap voltages and permits higher voltages to be used without electrical breakdown.

Figure 5 shows the junction of the linac and main ring tunnels. The ion source and Cockcroft-Walton set will be housed in the enclosure which can be seen in the distance at the left. The linac tank will be supported on the line of pedestals in front of this enclosure, and the beam will be injected at 50.8 Mev into the ring near the point from which the picture was taken.

The beam will be conducted from the linac into the main synchrotron ring through an elaborate injection system of debunching, deflecting, focusing, and

monitoring gear mounted on the four floor-level pile caps shown in the left foreground of Fig. 5. At injection into the ring, the beam will be about 1.7 inches in diameter and will comprise several milliamperes of protons with a total angular spread of 5 milliradians (diverging horizontally and converging vertically) and an energy spread of about 0.1 percent.

Ring Acceleration

In the linac each proton passes each accelerating gap only once. By deflection into circular orbits the protons may be made to pass many times through each acceleration station around the ring. The magnet arrangements for producing the circular orbits are discussed below.

There will be 12 radio-frequency acceleration stations around the ring at the points marked *X* in Fig. 1. Each station consists of a double tunable radio-frequency cavity (as shown in Fig. 6) which will impose accelerating electric forces on the proton bunches at each passage by means of a pair of accelerating gaps about four feet apart in the vacuum chamber wall; the gaps are made vacuum-tight with ceramic insulators. At each passage, each station (two gaps) will accelerate the protons by 8000 volts—that is, the protons will gain about 96 kev from the 12 stations for each transit around the ring.

On this basis, the protons must go around the ring 260,000 times, or 130,000 miles, to gain 25 Bev in energy.

As the energy increases, the velocity of the protons will increase rapidly at first and then more slowly as the protons approach the velocity of light.

Due to the velocity increase, the transit time of each proton bunch around the ring will decrease. Therefore, the frequency at the accelerating stations must be increased so that the protons will arrive at the gaps in the right phase to experience a forward or accelerating impulse. The cavities will be tuned to resonate at the right frequency by adjusting the permeability of the ferrite rings with which the cavities are loaded. The magnetic permeability of a ferrite is a function of the degree of constant magnetization which may be simultaneously impressed on it by a direct current. By the ingenious double-cavity arrangement shown in Fig. 6, the direct-current saturating bias may be superimposed on the alternating radio-frequency currents in the cavity walls.

The cavities will be operated on the 12th harmonic of the revolution frequency, and there will be 12 equally spaced bunches of protons circulating around the ring during acceleration. Since the protons are accelerated from less than one-third of the velocity of light to within a fraction of a tenth of one percent of light velocity, the frequency of the accelerating cavities will increase, in proportion, from 1.40 to 4.46 megacycles per second. To keep them in step, the power amplifiers for the 12 double cavities will be driven either in phase or 180 degrees out of phase from a common driving source. The exact frequency and phase of the driving source will be governed by the revolution frequency and radial position of the proton bunches, as sensed electrically by suitably placed "pickup electrodes" within the vacuum chamber.

Target and Experimental Areas

Two methods of conducting experiments with the accelerated protons are contemplated.

At first, target substances will be suddenly inserted into the beam in the vacuum chamber to intercept the circulating procession of protons, thus producing the reactions to be studied by means of the radiations emitted. Ultimately it is planned to deflect the beam of high-energy protons out of the vacuum chamber, as has been done very successfully with the 3-Bev protons produced by the cosmotron. Ejection greatly enhances the usefulness of the machine because many separate experiments may be simultaneously set up along the path of the beam and the direct beam may be used by each as needed. The large earth dike visible below the cosmotron building in Fig. 2

had to be constructed as a backstop for the ejected beam.

The target building and experimental areas are shown at the right in Fig. 1. With targets in the vacuum chamber, positive product particles would tend to be deflected to the west (left) in the fringing field of the magnets; negative particles, to the east. When the beam is ejected, it will pass east of north through the target building and out across the larger of the two outdoor experimental areas.

The target building, visible at the left of the ring in Fig. 2, is 100 feet wide by 252 feet long and 40 feet high. A 40-ton traveling crane spans its width, and 14,000 tons of heavy concrete shielding cover the ring within the target building, as is shown in cross section in Fig. 7, to intercept most of the intense radiations. Channels can be built through the shield-



Fig. 2. Aerial view of construction of the Brookhaven alternating gradient synchrotron in May 1957, looking south. The size of the AGS may be compared with that of the cosmotron, housed under the large flat roof at upper right.

ing by rearranging small plug blocks in the median plane for selected experimental beams.

Figure 7 also shows the construction of the floor slab for supporting the shielding weight, to minimize the effect on the piles carrying the main magnet ring; sheet piling has been inserted around each set of piles in the target building to isolate the piles even more from the effects of the local shield loading.

Magnet Ring

In describing the acceleration of the protons from source to target, we postponed discussion of the main magnet ring. The magnets perform two functions: (i) guiding the proton beam into a circle and (ii) focusing the beam.

The deflection of the protons into a circular path is accomplished by the force exerted on a charged particle mov-

ing across a magnetic field. This phenomenon is essentially three-dimensional and awkward to describe by two-dimensional diagrams. In the alternating gradient synchrotron the magnetic field at the median plane of the orbit (for example, the plane of Fig. 1) is directed vertically downward, from the zenith toward the center of the earth. The protons from the linac shown at the left of Fig. 1 move southward (toward the bottom of the page in the figure), and, being positively charged, they will experience a force toward the east which guides them into the ring.

As the direction of the horizontal velocity v of the charge e changes, the direction of the deflecting force $F = Bev$ also changes so that F is always at right angles to both v and the vertical magnetic field B . Note that this deflecting force does not change the speed or kinetic energy of a particle; it only changes the direction of its velocity.

Each of the 240 magnets around the AGS ring will deflect the protons by about 1.5 degrees, or 360 degrees in all, to complete the (nearly) circular path. The reference circle is 842.90 feet in diameter. The physical length of the magnets occupies about two-thirds of the circumference, the rest being available as straight sections between magnets for other equipment, such as acceleration stations and vacuum pumps, and equipment for injection, targeting, ejection, and so on.

A typical magnet cross section is shown in Fig. 8, which is a photograph of one of the laminations of which the magnet cores are being assembled. In "open" magnets, the gap shown at the left flares away from the "back leg" at the right. There are also "closed" magnets in which the gap has an identical contour but flares toward the back leg.

The careful pole shaping is required for the focusing function of the magnetic fields, to be discussed below.

A nearly elliptical vacuum chamber, just over $6\frac{1}{2}$ by 3 inches inside, will be centered in the gap between the magnet poles on the "aperture center line," which lies 5.25 inches from the open side of the poles, where their vertical separation is 3.500 inches. A pressure of 10^{-6} millimeters will be maintained in the whole vacuum chamber by 48 titanium getter-ion pumps distributed around the ring to prevent undue loss of protons by collision with residual air molecules. The chamber is made of nonmagnetic Inconel X, 0.078 inches thick, which offers relatively high electrical resistivity against eddy currents.

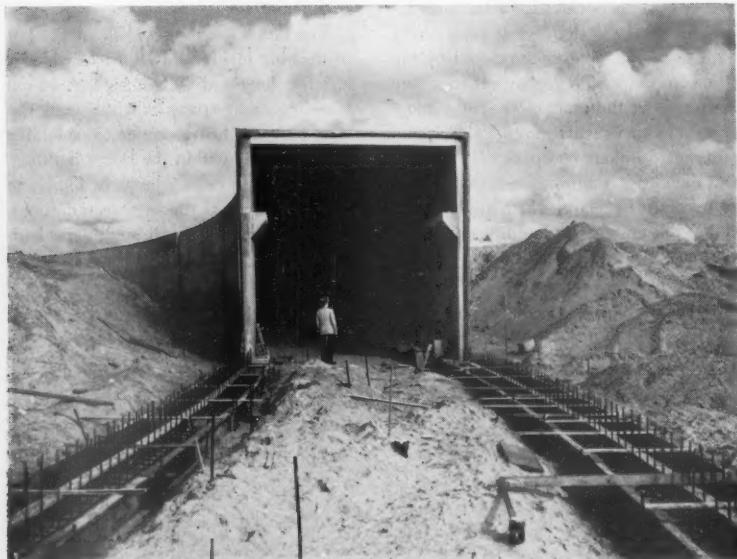


Fig. 3. Section of the Brookhaven alternating gradient synchrotron magnet tunnel during construction.



Fig. 4. Experimental section of linear accelerator tank with three drift tubes. The protons will pass through the axial hole in the drift tubes.

Magnets

Figure 9 shows an assembled magnet of the "closed" type with the magnetizing coils in place. Each of the four coil sections or "pancakes" consists of eight turns of extruded rectangular copper, 1 and $19/32$ inches wide and $1/8$ inch high, with a $3/8$ -inch-diameter cooling water hole in the center and about 0.001 ohms resistance per pancake.

The closed magnet shown is 90 inches long and consists of about 2800 laminations of 0.031-inch steel plus 1-inch end plates. It is held together by the eight longitudinal straps, which were welded to the outer periphery while the laminations were compressed by a force of 80 tons. The core shown weighs 15 tons; the copper, 3200 pounds. The laminations are insulated from one another by a varnish to inhibit eddy currents. About 98 percent of the core volume is steel. This excellent lamination factor shows that the steel produced for the AGS magnets is unusually flat.

The 96 "closed" magnets are all of the 90-inch length shown in Fig. 7. There will be two lengths of "open" magnets; 48 will be 90 inches long and 96 will be 75 inches long, giving a total of 240 magnets in the three classes: *A*, "long open"; *B*, "short open"; and *C*, "long closed."

The flaring magnet gap illustrated in Fig. 6 is essential to the alternating-gradient strong-focusing system. Exceptionally stringent mechanical tolerances and magnetic uniformity are required to hold the protons within the 3-by- $6\frac{1}{2}$ -inch vacuum chamber while they travel more than 100,000 miles! The roughly hyperbolic pole contour is being held to ± 0.002 inch of the prescribed form by punching the 633,000 laminations with a very accurate carbide die. The blanks are reversed right to left by pairs before punching to compensate for residual variations in thickness from side to side; after punching, every 20 laminations are turned over, top to bottom, in stacking the magnets in order to keep the gap contour symmetrical about the median plane through the gap. The latter inverts the shearing direction in the punch and gives rise to the attractive striped appearance of the core in Fig. 9. The tolerances on straightness of lamination stacking, placement on the ring, and so on, are all of the order of ± 0.010 inch.

The magnets will be placed by pairs on 120 large steel girders, some of which are visible on the right in Fig. 5. The ends of the girders are supported on piles. Each pile cap, as seen in Fig. 5, is mechanically separated from the tunnel

floor and covers four 10-inch H-section steel bearing piles driven about 50 feet into the sand and gravel of Long Island, which extends hundreds of feet down and has been undisturbed for thousands of years. There are 120 sets of four piles each, and this foundation for the ring is considered to be exceptionally advantageous in view of the stability problems faced by synchrotrons constructed elsewhere. Sand acts as an effective damper for earth tremors and eliminates dangers of faults occurring in local substrata,

with the accompanying physical shift of adjacent regions.

Magnet Power Supply

As the energy of the protons increases during acceleration, their momentum, p , also increases. To hold the orbits to the over-all ring curvature set by the vacuum chamber, the deflecting magnetic fields B must increase in proportion to p . A 100-fold increase in B is required in a

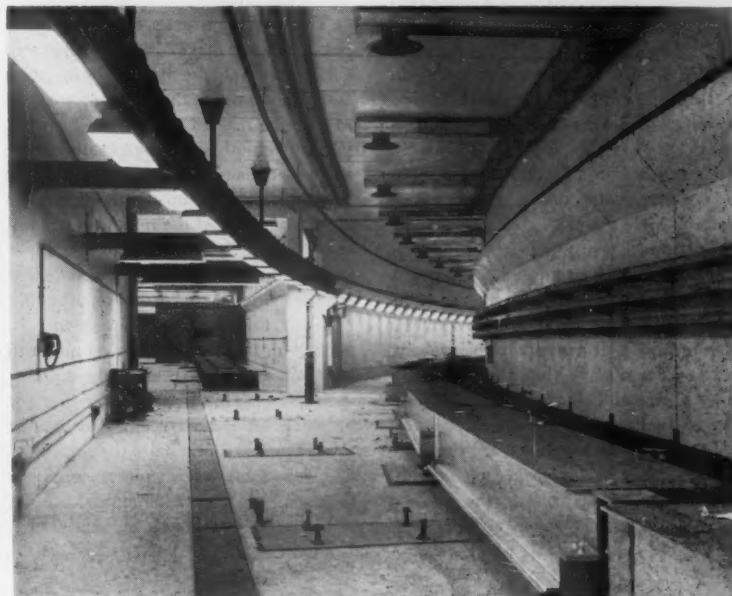


Fig. 5. Junction of linear accelerator and main ring.

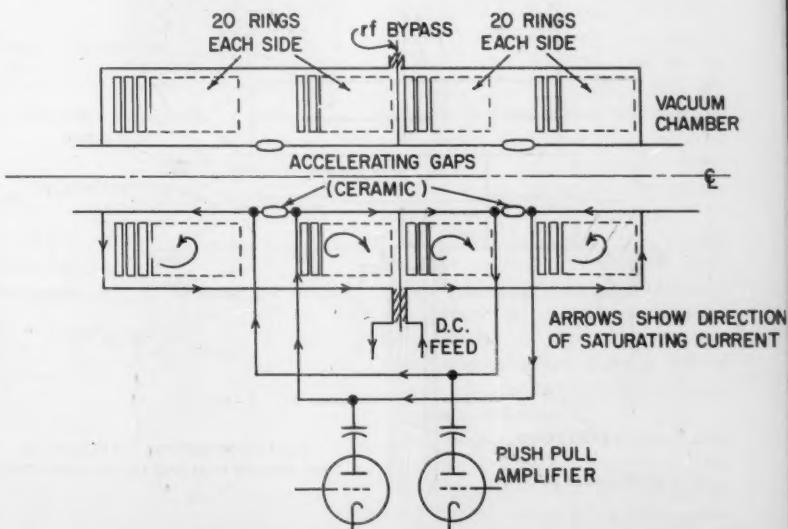


Fig. 6. Cross section of radio-frequency cavity at each acceleration station.

little over a second following injection at $B = 120$ gauss.

The magnets are energized by passing electric currents through the coils shown in Fig. 9. To make the field rise uniformly around the ring, the magnet coils are connected in series so that the same current will flow in all magnets. Actually there will be two such series circuits, each containing two of the four pancakes on each magnet. The currents flow in opposite directions around the ring in the two series circuits in order to avoid undesirable magnetic effects of a single turn around such a large ring. Further, a pulse-shaping saturating inductor will be included, and the two series circuits will be connected in parallel across the power supply, which consists of an ignitron-rectified, 12-phase, 36,000 kilovolt-ampere generator, a 47-ton flywheel, and a 5500-horsepower motor driven from 13,800-volt, 60-cycle mains.

For top-energy protons the accelerating pulse will be repeated 20 times a minute; it consists of a current rise from 0 to 6500 amperes in about 1½ seconds, followed by a decrease to zero in about a second and a waiting period of less than a second before the beginning of the next pulse.

Each pulse is started by firing the ignitron rectifiers in the proper phase; this applies about 5000 volts to the magnet circuit. The magnet current will begin to rise against the inductance and resistance

of the magnet circuits. As the current rises through 45 amperes the protons are injected from the linac, and ring acceleration begins and continues until the magnet current reaches about 145 times the injection value.

At top current, about 14 million joules of energy will be stored in the magnetic field of the magnets, and over 10 million watts will be being turned into heat in the resistance of the magnet coils. The heat will be carried away by cooling water flowing in the axial $\frac{3}{8}$ -inch hole in the coil copper.

To bring the magnet current down to zero again, the magnetic-field energy will be drawn off into the flywheel by inverting the phase at which the ignitrons are fired so that the magnet current flows *against* the electromotive forces generated in the alternator, causing it to act as a motor and thus speeding up the flywheel. The rotational speed of the rotating parts will vary from 815 to 875 revolutions per minute during the pulse, and the net electric-power demand will only be that required to supply the losses—that is, enough for the 5500-horsepower motor to maintain full speed before the start of each pulse. This ingenious scheme for handling the inductive energy stored in the magnet was originally developed for the cosmotron, whose power supply is almost as large as that required for the AGS, and it has proved eminently satisfactory.

Focusing

The research usefulness of an accelerator depends on beam intensity as well as on the top energy achieved. It is not enough to accelerate an ideal particle; as many actual particles as possible in the vicinity of the mathematical ideal must be kept from striking the walls of the vacuum chamber and kept in phase at the accelerating gaps so that they will arrive at the target at the top energy.

We may think of an actual particle as following a path which deviates radially and vertically from the ideal, nearly circular, equilibrium orbit. Focusing forces are those which tend to deflect the particle toward the ideal orbit, and the strength of focusing forces may be described by the frequency with which they cause an actual particle to oscillate back and forth across the equilibrium orbit. In the older "weak focusing" machines, such as the cosmotron and bevatron in this country and the synchrophasotron in Russia, these "betatron oscillations" take place less than once per revolution; in the AGS there will be $8\frac{1}{4}$ betatron oscillations per revolution and in the CERN proton synchrotron, or PS, there will be $6\frac{3}{4}$. For this reason the term "strong focusing" has been applied to alternating-gradient machines.

The AGS magnets are arranged in 12 identical 30-degree superperiods of 20 magnets each, as marked in Fig. 1. The arrangement within a superperiod is shown in Fig. 10. Magnets 1 through 10, numbered in the direction of the proton beam, from right to left, are placed with their back legs outside the ring on five successive girders; magnets 11 through 20 are in the same sequence as magnets 1 through 10 but have their back legs inside the ring. There are 10-foot straight sections between magnets at each back-leg reversal; 5-foot straight sections for auxiliary equipment following magnets 3, 5, 7, 13, 15, and 17; and only 2-foot straight sections to accommodate coils, vacuum chamber junctions, and so on between the rest, as shown.

The sequences of ten magnets with back legs all on the same side of the orbit leave open access to the vacuum chamber on the other side; this greatly facilitates tangential injection and ejection of the beam and leaves paths for product particles ejected from targets suitably placed in 10-foot straight sections. These advantages are the main reason for adopting a basic plan in which the back legs are placed all on one side of the orbit for long intervals.

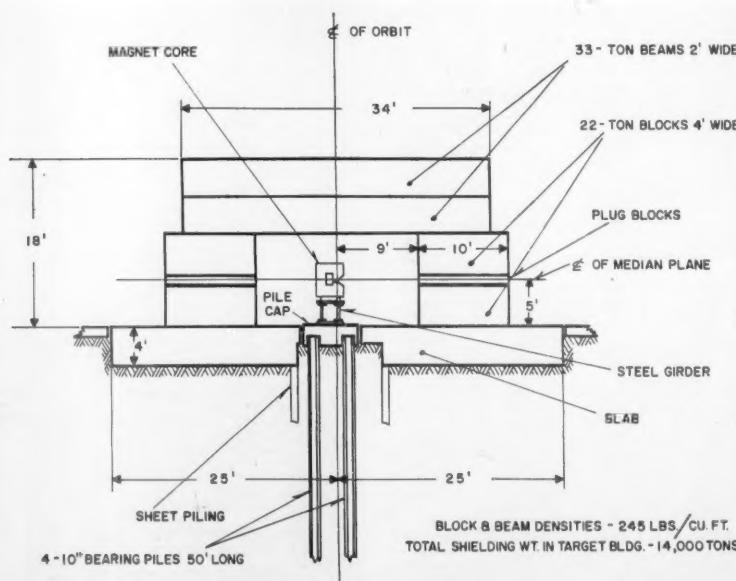


Fig. 7. Cross section of shielding and ring in the Brookhaven alternating gradient synchrotron target building.

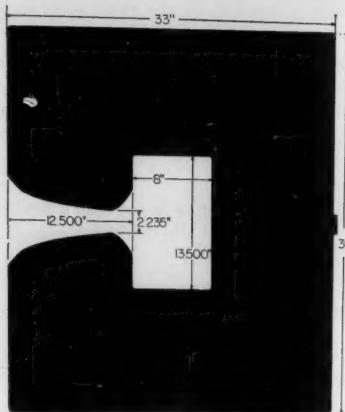


Fig. 8. An "open" magnet lamination, showing cross section of a typical AGS magnet.

The gaps of magnets labeled "+" in Fig. 10 flare toward the outside of the ring, while those labeled "-" flare toward the inside, regardless of the position of the back legs. The + and - magnets alternate in pairs, and four successive magnets constitute one alternating gradient period. Thus, the gaps of the four short magnets adjoining each 10-foot straight section flare away from their back legs; this accounts for the 96 short open magnets of class B. It can be seen that half of the magnets of each class are placed with their back legs inside the orbit, the other half with their back legs outside. By such means a maximum over-all symmetry of the guiding and focusing fields is to be attained in spite of residual random variations between and within magnet classes.

Within the flaring gap of each magnet the strength of the vertical component of magnetic field decreases toward the open side of the gap; this means that particles are deflected less strongly (that there is a larger radius of curvature of path) in the wide than in the narrow side of the gap. With large magnetic field gradients, a + magnet tends to defocus the beam in the horizontal direction; the converse is true for a - magnet.

The essence of the alternating gradient discovery (1) is that a regular succession of focusing and defocusing elements can produce a strong net focusing action. The phenomenon is not easy to explain in elementary terms. Both focusing and defocusing elements exert stronger forces the farther away the particle is from the equilibrium orbit. It turns out that, in focusing sections, the particles are, on the long average, farther from the equilibrium orbit than in defocusing sections. Therefore a net focusing action results.

The nature of a quasi-static magnetic (or electric) field in free space is such that the "curl" of the field is zero—that is, if the vertical upward component of the field increases as the reference point moves horizontally to the right, then the horizontal component to the right will increase just as fast as the reference point moves vertically upward. A consequence of this fact is that a + magnet, which defocuses the beam in the horizontal direction, will focus the beam in the vertical direction, and conversely. Thus + magnets in Fig. 10 focus in the vertical direction and - magnets defocus in the vertical direction. Alternating-gradient focusing is provided in both the horizontal and vertical directions, and when the same amount of strong + and - focusing is provided around the ring, the net alternating-gradient focusing forces will be about the same in both the horizontal and vertical directions—that is, there will be nearly the same number (8 1/4) of betatron oscillations in one revolution both vertically and horizontally.

In a linear accelerator the electric fields that accelerate the particles longitudinally in the gaps between drift tubes also tend to defocus the beam laterally. Hence, in the AGS linac, magnetic alternating-gradient lateral focusing will be provided by placing quadrupole magnets within the drift tubes (2).

So far we have really considered only particles of a given energy and their lateral deviations from the equilibrium orbit for the corresponding momentum.

Synchrotrons would not work at all unless a kind of longitudinal focusing

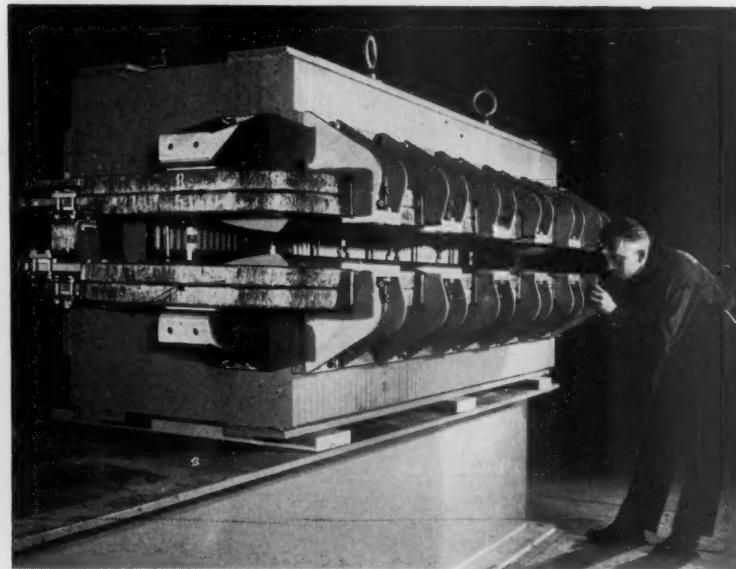


Fig. 9. An assembled "closed" magnet with coils in place.

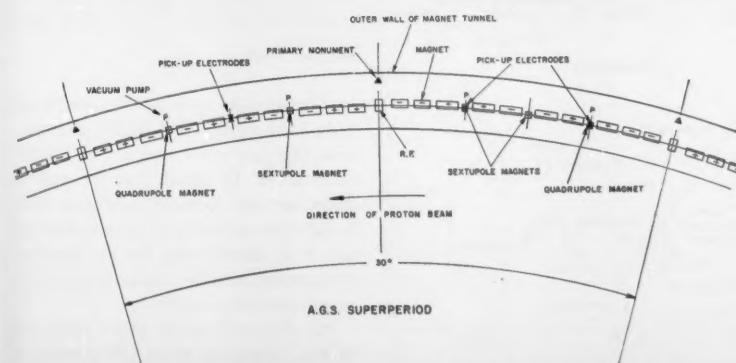


Fig. 10. Detailed plan of each of the 12 superperiods in the magnet ring that is shown schematically in Fig. 1.

could also be provided, tending to hold particles of different energies in bunches which pass the accelerating gaps in synchronism with the applied radio frequency and within a required phase interval of the radio frequency (3). Our word *synchrotron* and the Russian *synchrophasotron* arise from this fundamental requirement for effective acceleration.

Particles of somewhat different energies within a bunch will have correspondingly different momenta and speeds. The

different momenta will have different equilibrium orbits, and the time required for one transit around the ring will depend on both the circumference of the equilibrium orbit and the speed. The facts of relativity determine this transit time.

When the mean proton kinetic energy in a bunch is below about 7.2 Bev, protons whose energy is somewhat larger than the mean will tend to arrive sooner than the mean at the accelerating gaps because their transit time around the

ring is smaller. If the radio frequency current is phased so that the accelerating potential across the gap is rising at each passage of the bunch, then higher energy particles, arriving early, will collect a smaller energy increment from the gap than lower energy particles arriving later. The resulting tendency to equalize the particle energies in the bunch finally causes the particles in the bunch to oscillate in energy and phase, and the frequency of this oscillation is a measure of the "bunching" forces.

Above 7.2 Bev the particle speeds are already more than 99 percent of the speed of light and therefore cannot increase much more. Protons having more than the mean energy in a bunch now tend to take longer to go around the ring because their equilibrium orbit is longer than the mean for the bunch. Thus, they arrive later at accelerating gaps, and acceleration must be phased on the falling side of the radio frequency if they are to receive smaller energy increments than the mean particle.

Therefore, to preserve synchronous stability for the bunches, the phase of the accelerating radio frequency current must be changed from the rising to the falling side rather abruptly as the "transition energy," about 7.2 Bev, is passed. Elaborate experiments with an "electron analog" machine at Brookhaven have shown that this phase shift can be accomplished with very little loss of beam.

The "breathing" of the equilibrium orbits with changes of particle energy relative to the mean energy in the bunches constitutes a "synchrotron" oscillation which is superimposed on the betatron oscillation discussed above. The synchrotron oscillations broaden the beam in the horizontal direction only, and this is the main reason why the vacuum chamber is made wider than it is high.

Magnet Steel

A maximum number of protons are to be held within the 3-by-6½-inch vacuum chamber while they travel 150,000 miles or so. To insure that the various deflecting and focusing conditions shall be fulfilled uniformly all around the ring and at all times during the acceleration, the magnets must be magnetically as well as mechanically accurate.

An electrical grade M-36 steel was chosen, containing about 1.80 percent of silicon and 0.03 percent of carbon. Be-

PARTICLE ACCELERATOR DEVELOPMENT

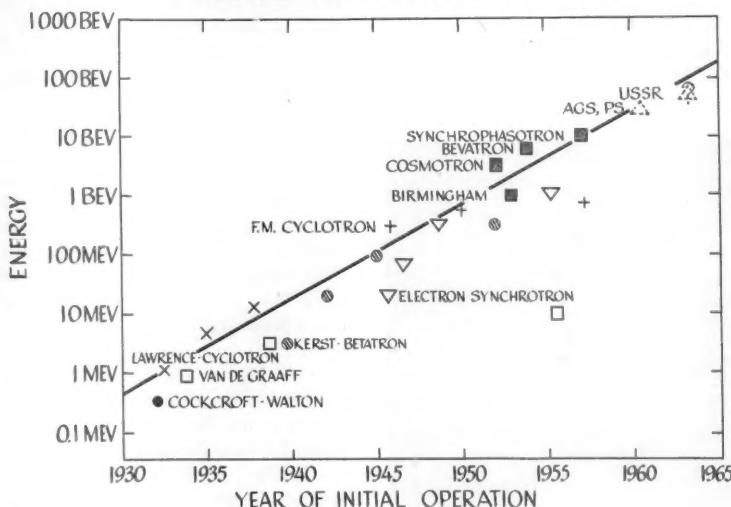


Fig. 11. Increase in particle energies achieved by accelerators during the last few decades.

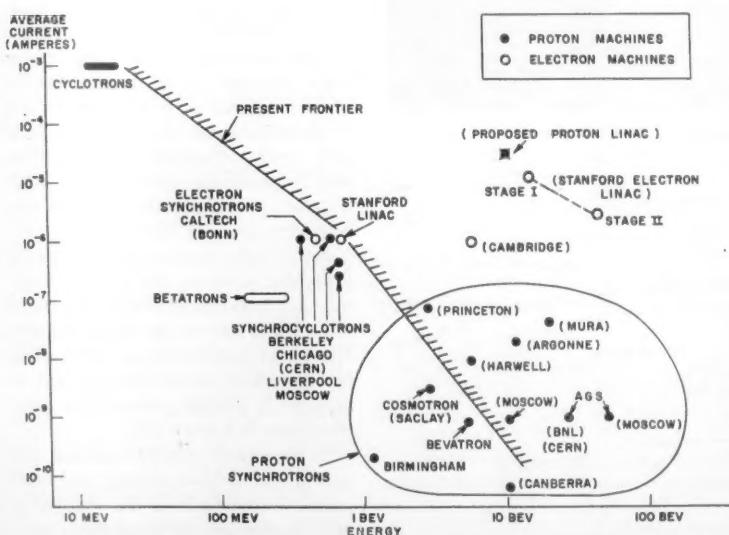


Fig. 12. Trend toward lower intensities with increase of accelerator energies.

fore the current is turned on for a pulse, the remanent field at the aperture center line is about 15 gauss, due to the magnetization remaining in the steel core from the previous pulse. The value of this remanent field depends mainly on the coercive force of the steel, which averages around 0.77 oersted. As the pulse current rises, the injection-field value of 120 gauss should be reached simultaneously in all magnets. The increase above remanence depends mainly on the gap size and shape, but it depends partly on the low-field permeability of the steel, which averages about 740 at 100 gauss.

During the main part of the cycle, up to 10,000 gauss and more, the fields depend almost completely on the gap geometry, because the permeability of the steel is very high. By 11 or 12 kilogauss, the saturation of the steel becomes noticeable, especially since the flux density in the pole tips near the closed part of the gap can exceed B at the aperture center line by 50 percent or more. The onset of saturation distorts the field distribution, especially toward the closed side of the gap, and thus sets an upper limit to the proton energy that can be attained. An average permeability approaching 140 at 18,000 gauss is attained by the AGS steel.

The stringent AGS demands for magnetic uniformity around the ring and at all times during the rising pulse cannot easily be met by commercially produced steel, even with the special care used with the 4000 tons of AGS steel. Two related problems are involved: (i) coercive force and low-field permeability show standard deviations of from 10 to 15 percent from the mean, and (ii) both properties show an "aging" deterioration of 60 percent or more, as determined by accelerated aging tests in which samples are subjected to a temperature of 150°C for 5 days. It is assumed that it will take many years for the same aging to take

place at room temperature. Fortunately the high-field properties show no appreciable aging.

The first line of defense against these large variations in the steel has been to shuffle or interleave the steel for each of the three magnet classes according to a careful plan so that the steel from a given billet and rolling-mill coil will appear in all magnets of a given class at the same relative position and for about the same number of laminations. This shuffling reduces the residual variations between magnets to the order of 0.1 percent, even at injection, and will minimize them throughout the aging process, extending over several decades.

In addition to these measures to insure uniformity, a number of provisions have been made for final trimming of the orbits in the machine. Figure 10 shows the position of pickup electrodes and quadrupole and sextupole magnets in each superperiod, as well as the primary survey monuments. At each pickup electrode location, both the horizontal and vertical positions of the beam can be monitored electrically, sufficient in all to diagnose various harmonic distortions of the equilibrium orbits. On the basis of such information the correcting multiple magnets and windings to be attached, if necessary, to the outside of the vacuum chamber can be powered to hold the orbits near the center of the vacuum chamber and to compensate, to a degree, for field distortions due to magnet saturation toward the end of acceleration.

The magnets are being positioned on the ring with reference to the primary survey monuments shown in Fig. 10. Each primary monument is driven into the underlying sand and is mechanically separate from the tunnel base and ring piles. From each monument straight lines of sight are available within the tunnel walls to the two adjacent monuments on either side. By means of a high-

precision survey, distances between adjacent monuments have been determined to a thousandth of an inch; triangle closures, to one-third of a second. Periodic resurveys will be carried out to monitor stability and possible movements of the soil.

Particle Accelerator Development

In this brief description of the Brookhaven alternating gradient synchrotron we have tried both to outline the principal physical ideas involved and to indicate the organization, precision, and range of special technologies involved in a large project of this sort, all aimed at penetrating nature's secrets in the fantastically small atomic nucleus.

The development of particle accelerators (4) has been essential to the advances in nuclear physics and high-energy physics that have been made in the past few decades. Increases in both energy and beam intensity are ardently sought by workers in these fields.

Figures 11 and 12 show graphically how peak energy has increased with the year of initial operation for various accelerators and how the intensity, measured by the average beam current, tends to decline with increasing energy. Parentheses in Fig. 12 indicate machines which are only in the planning or construction stage, even though some (for example, Saclay and Bonn) are scheduled for completion this year.

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Teleology in Science Teaching

Professors and textbooks alike make uncritical use of teleological and anthropomorphic language.

A. J. Bernatowicz

Each of us is for good and against evil. For most teachers of science, teleology and anthropomorphism are not issues to be debated but to be deplored—we stand against the evil. In keeping with this attitude, I shall not here debate with any who may have philosophical convictions in favor of teleology; their concept of the good differs from mine. I do intend to challenge those of us who argue against teleology but permit it to appear in our own lectures and ignore it in assigned readings.

If science is taught as a body of information, if a science course earns that ever-to-be-prized encomium, "a course with plenty of meat and a hard, solid core of facts," then a certain indifference to frills such as rigorous exclusion of teleology is not surprising, and an obliviousness to imprecise language must be expected. On the other hand, "light-weight" courses, courses designed to meet liberal-arts objectives through an examination of science as an intellectual discipline or through study of scientific attitudes and methods, are likely to contain at least *some* explicit treatment of these "evils," together with some examples of objectionable phraseology which the student (but not the instructor?) is expected to avoid. When teleological, animistic, or anthropomorphic expressions escape notice in the latter type of course, we should perhaps shrug philosophically and admit that we cannot expect the same perfection in professors that we demand in students. Nevertheless, whatever the approach to science teaching, careless language seems inconsistent with our pious declarations against "evil." Evidences of careless language are not hard to find in texts, and a random selection to substantiate this

point is quoted below. They may be even more common in lectures, although this is more difficult to document since one has so little occasion to listen to his colleagues' lectures and one's own lectures are without blemish! Quiz questions are also likely to be "contaminated"—probably the most unkind cut of all to students. In short, it appears that, despite our almost unanimous disapproval of teleology and anthropomorphism, they are far from lacking in our instructional material and, I will argue, far from absent from our thinking.

The Usual Excuses

Before reading the evidence, perhaps we should review some of the reasons given by authors and lecturers for their lapses into teleological and similarly "unscientific" language. Commonly, these reasons are accompanied by disclaimers of "evil" intent.

First, there is the argument that the objectionable phraseology is used only to avoid "awkward circumlocution" or "tiresome periphrasis." At least in some instances it can be shown that greater rigor can be achieved without awkwardness, and it is debatable whether rigor should be subordinated to simplicity.

Second, the claim is often made that the objection is purely a semantic one, a mere quibble, and that the words under consideration are as suitable as any others. Here we can only counter with the army claim that "if an order *can* be misunderstood, it *will* be misunderstood." Too often an acrimonious dialogue ensues from which it emerges that "I am more rigorous than thou."

Third, we hear the excuse that vivid writing or intimate lecturing may justi-

fably sacrifice rigor in the interests of more effective rapport. Since greater rapport is presumed to increase learning, we have the paradox that the students are learning best that which we do not want them to learn.

Fourth, quiz questions, especially on objective quizzes, are said to require directness and brevity; they are to be questions on course material rather than on ability to read rapidly, and therefore brief teleological or anthropomorphic phrases may be excused "so long as the students know what is required." This interesting philosophy seems to maintain that grades may depend upon students' acceptance of terminology that the professor would condemn if it came from a student. There is also something pernicious in the attitude that rigor is a luxury we cannot afford when something so important as a quiz is in the balance.

Examples of Nonrigorous Language

With these excuses in mind (and no doubt others can be adduced), let us look at examples taken from texts and books of the sort recommended for collateral reading. That the majority of the examples come from books on biology should give little comfort to physical scientists, inasmuch as more biology books than others were conveniently at hand. Even without a thorough inspection, examples were found in every book examined, whether the subject was biology, chemistry, physics, astronomy, or geology. The quoted examples by no means include all those which were noted.

Rather uncommon are the explicit statements of goal or purpose, perhaps because such statements are not inadvertent but represent a deliberate attempt to produce some (undiscovered) effect:

"It [the universe] emerged full-armed, as it were, out of nothing, apparently for the sole purpose of blazing its way to an eternal death" (1, p. 26).

"The structures named in quotation marks [root, stems, leaves of stoneworts] are not anatomically like the true roots, stems, leaves and seeds of higher plants, but they do serve similar purposes and show a remarkable degree of differentiation for an alga" (2, p. 498).

"Most green algae produce flagellated or amoeboid reproductive cells whose special purpose is to function as gametes" (3, p. 22).

"One purpose of food is to act as a

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fuel for our bodies, supplying us with heat and muscular energy" (4, p. 384).

"Whatever the valley shapes produced in various stages of landscape development, whatever different kinds of rock may be present, the ultimate goal of stream erosion is to reduce the land surface to a nearly flat plain approximately at sea level" (4, p. 510).

Beware the infinitive form of the verb. In each of the last three quotations it is intimately involved with outright teleology. In more subtle contexts it is the most common producer of teleological implication. From the above statements of "goal . . . is to reduce" or "purpose is to function," we can continue with a graded series of quotations arranged to show that, regrettably often, *to* is merely an abbreviation of *in order to*:

"Very little is known concerning these forces, except that they must be considerable in order to overcome the normal repulsion between the positively charged particles in the nucleus" (5).

"In combining with other atoms, the atoms of an element *strive to attain the stable arrangement of electrons that characterizes the inert atoms of the elements of Group 0*" [italics in the original] (6).

"Seeds are modified to function as agents in the distribution of the species" (7, p. 520).

"Sand grains, pebbles, and boulders are the tools which a stream uses to dig into its bed" (4, p. 503).

"The ammonia molecule can attach a proton to itself, to form an ammonium ion, NH_4^+ . . ." (8, p. 237).

"In this form, each [helix of DNA] will be free to attach to itself nucleotides or their precursors from the environment within the cell, to replace each complementary base that was separated from it in the unwinding and bond breaking" (9, p. 376).

"Cells of the archesporial tissue (the endothecium) divide and redivide at various angles to form a massive sporogenous tissue" (10).

"Each of these [rotating rings of gas] would condense to form a planet" (1, p. 74).

Use of the infinitive in the manner of the last two examples is so very prevalent that we must assume that authors, editors, and readers (and lecturers?) consider it unobjectionable and will defend it. Of those who insist the matter is one of far-fetched interpretation ("you're quibbling") we may ask at what point in the graded series they can confidently plan to change a speech habit. And even

if they do stop short of undeniable teleology, are they confident that students will do so—that students will not slip into uncritical acceptance of overt as well as subtle teleology? Others may feel that the infinitive in these cases is the most direct and simple mode of expression, and that its avoidance would require "awkward circumlocution." There is a simple remedy, however; substitution of *and* for *to* is quite sufficient in the majority of instances that are not complicated by other infections of animism or anthropomorphism.

Teleological Thinking

And it is this very point, that generally a mere substitution of *and* for *to* will eliminate the most common examples of teleological phrases, which discloses the real danger behind the use of these phrases in our teaching. The danger is not that we teach "unscientific" terminology but that we are actually thinking teleologically and communicating these modes of thought to students. How else can we interpret the circumstance that, when two sentences differing in but a word can be formulated (compare "hydrogen and oxygen combine *to* form water" with "hydrogen and oxygen combine *and* form water"), we apparently find it easier to formulate the one with teleological overtones? If the alternative formulation appears awkward, it would seem that the awkwardness is not due to circumlocution but to interference with our predilection for certain modes of thought.

To return to the evidences of objectionable expressions in books, let us note another too frequently employed word, *for*. This time the series is arranged to show the more subtle usage first and the overt examples at the end:

"They [insects] have solved the problem of flight, which gives them immense advantages for dispersal, for seeking out appropriate growing places for their young" (11).

"Resting spores of the akinete type, which are structures for tiding the algae over unfavorable periods, usually germinate into a vegetative filament as soon as favorable conditions return" (3, p. 285).

"In the insectivorous or carnivorous plants, e.g., Venus flytrap, bladderwort, and pitcher-plant, leaves are modified for the capture of insects and other animals" (7, p. 531).

"There has to be some sort of mecha-

nism for raising sap [in trees], and energy is lavishly expended in the process" (2, p. 139).

"Because of the unique ability of leguminous crops to convert nitrogen—from the soil nitrate or ammonia, or from the air—into bulk protein for feeding animals and other purposes above-ground, and for addition to the stock of organic matter and of plant-available nitrogen in the soil, the crux of food-supply on the modern scale is to render enough of the earthy nutrients, and of lime, phosphate, and potassium especially, available to the legumes" (12).

"In order for growth to occur, materials must be taken from the environment and incorporated into the developing body" (9, p. 17).

Sometimes a word with obvious teleological connotation becomes so familiar in limited context that it becomes a conventional term, a quasi-technical word, no longer subject to criticism. One which is almost at that status in biology is *store* and its derivatives. *Store* connotes provision for the future—purposeful accumulation. A better choice is *accumulate* (or its derivatives), since it is noncommittal concerning purpose or intent. Although it may be claimed that *store* in the biological sense has a special and irrefutable meaning, it is to be doubted whether students change their understanding of the word when they enter and leave the classroom. Of the next four examples, those combining *store* with *reserve* or *function* are especially likely to lead students astray, but none of the examples would suffer if *accumulate* were substituted:

[In a description of food chains], "Others, the consumers, will be present because, directly or indirectly, they can utilize the food and its energy which is provided by the producers, whether it is an excess they have stored or the producer itself, usually after death" (13).

"Starch is stored by plants in tubers, seeds, and fruits, and a similar substance called *glycogen* is stored by animals in the liver" (4, p. 424).

"In some plants, e.g., *Portulaca* and century plants, the thick leaves function as water storage organs" (7, p. 531).

"Cells of *Dinophyceae* store their photosynthetic reserves as starch or as oil" (3, p. 151).

Somewhat akin to the question of *accumulate* versus *store* is the substitution by many biologists of *interphase* for *resting phase*. Curiously, the objection to *resting phase* as applied to a nucleus has generally been that the nucleus is quite

active metabolically during this phase. But, irrespective of whether or not the nucleus is active, the very notion of a nucleus *resting* between divisions should have been considered to be far too anthropomorphic. Yet despite the twofold argument against *resting phase*, this phrase retains some degree of currency, presumably because it is considered a technical expression.

Even if careful biologists are willing to substitute *interphase* for *resting phase*, they have no similarly easy choice for various other words which impart more or less technical meanings—for example, *dominance*, *competition*, *selection*, and *function*. If not carefully used, such words lose the respectability granted to technical terms and communicate their intrinsic connotations of anthropomorphism, animism, or teleology. This is, I think, apparent in connection with *function* in some of the previous quotations. *Selection*, for which some biologists expect salvation because its unfortunate implications are freely admitted, is hardly innocuous when it is described as entailing a choice by the environment, as in the following:

"Artificial selection is a process similar to natural selection, except that the variants that leave the greater progeny are chosen by man rather than by the general environment" [italics in the original] (9, p. 247).

Perhaps these examples from biology textbooks represent merely unfortunate choices of words for concepts which are not in themselves unsound. We can hope so, and leave analysis of the concepts to the philosophers of science, since our present concern is with the words per se and their effect on students' thought. But in physics there is used a familiar word which surely must disturb some thoughtful students, and as for the idea it represents, see what Erwin Schrödinger (14) has to say: ". . . the notion of force, the most dangerous relic of animism in this science." "Force," a cornerstone of Newtonian physics, a word and a concept that pervade our language and our thinking—if this is suspect, then what of the vocabulary of the less exact sciences?

Hints at the Supernatural

Not the least of the nonrigorous language habits in science teaching is that of implying the activity of a supernatural being. To the beginner, the idea of natural law presupposes a lawgiver, and this extrapolation is confirmed when we

state that phenomena occur in obedience to natural laws, or when we imply such obedience by the words *must* or *has to*. For example, in one lecture I declared that an excited electron has to give up the absorbed energy when it returns to a lower energy level. A bright student should have pointed out that the electron doesn't *have to* give up the energy, it just *does*. In like manner, the idea of a planner may be conjured up by the idea of order or plan in the universe, particularly if other words support the inference. Note the mutual reinforcement of *plan* and *constructed*:

"It was he [Copernicus] who revealed to us, in its broad outlines, the plan upon which the Universe is constructed, or at least that part of the Universe which is of most immediate interest to us" (15).

Or, isn't it a sublimation of tendencies toward supernaturalism when nature is personified (deified):

"For we know, from ordinary observation, how exceedingly wasteful and haphazard are nature's means of securing her ends" (1, p. 23).

These hints at the supernatural call to mind the "why" questions, which, admittedly, are often thought-provokers. Not uncommonly these questions do not provoke beginners into causal thinking, and insofar as they tempt students into seeking reasons other than causes, questions such as the following would be more appropriately put to a class in metaphysics than to one in science:

"Why, for example, should the proton have eighteen hundred times the mass of the electron?" (1, p. 188).

"It [Bohr's theory] left unexplained such questions as why an electron preferred a small orbit to a large one, why in its jumps it chose one small orbit in preference to another, why it could not move in other orbits than the discrete ones required by the hypothesis" (4, p. 321).

It is very easy to explain to the student that "why" in science requires a mechanistic rather than a teleological answer. It is not so easy to get him to adhere to this requirement, especially in biology. Rare indeed is the student who will explain "why a salmon swims upstream" in mechanistic terms. Incidentally, I have found considerable shock value in confronting classes with two questions in succession: (i) Why does a potted plant bend toward a window? (ii) Why does a moth fly into a candle flame? At least temporarily the class realizes the advantage of rephrasing with "what causes . . .," but more than a single device is needed to overcome the

continuous beguilement into teleology, animism, and anthropomorphism to which our students are subjected.

I will not attempt to classify the remaining few quoted passages. In addition to the specific words which are objectionable (italics mine), the general tenor of these passages seems unnecessarily nonrigorous:

"In Infusoria, where the macro-nucleus normally divides in this *artless* way [amitotically], the micro-nucleus divides mitotically. The whole process of mitosis is an elaborate way of *ensuring* that the genes which are localized in the chromosomes shall be exactly distributed among the daughter nuclei (16, p. 69).

"Obviously blood *must not* clot inside the blood vessels, as it would block the circulation . . ." (16, p. 145).

"As the temperature increases the molecules become more and more agitated; each one bounds back and forth more and more vigorously in the little space left for it by its neighbors, and each one strikes its neighbors more and more strongly as it rebounds from them" (8, p. 44).

"So eager are sodium atoms to lose electrons, so anxious are Cl atoms to receive them, that the combination is extremely violent, accompanied by the evolution of much heat and light" (4, p. 335).

But why worry about it? Few of us would offer a brief in support of teleological language, but can't we be tolerant of occasional contaminations? Must our language be made aseptic? I maintain that we should try, and this means giving more than lip service to the attempt. Lip service is not merely insincerity; it may lead to unjustified feelings of security. In one of his expositions of operationalism Bridgman makes a point that applies here. He says (17), "The true meaning of a term is to be found by observing what a man does with it, not what he says about it." So also, though we say we are against teleology and all the rest, we use these ideas in our language and thereby display the extent to which they affect our thinking.

Suggested Remedies

What can we do about it?—other than be more careful, that is. Carefulness is a rather passive approach; it may protect students from being led astray, but it is hardly likely to teach them to avoid the pitfalls consciously. If a little class time can be devoted to the problem, it can be a rewarding topic, not only for its

own sake but for its reinforcement of other topics. The following active approaches have been used in a large class (400 students) to sufficient advantage to encourage further attempts. First, we presented justification for our avoidance of the teleological, animistic, and anthropomorphic viewpoints, as follows.

1) When mechanistic explanations are available, teleology and its allies violate the principle of parsimony. (Pointing this out is one of the easiest means of elucidating the application of Occam's razor.)

2) Teleological and similar elements of explanations are probably never heuristic in the natural sciences. (We used this point to reinforce discussion of the criteria of a good theory).

3) Questions formulated in teleological and similar styles are "meaningless" in the sense that they are not susceptible of scientific investigation, whereas restatement in rigorously mechanistic or operational terms will often indicate the means of attacking the problem. (Substitute *what causes* in questions that begin with *why*).

To pursue this active approach, we attacked textbook statements, some of which are quoted in this article. Some-

times passages were dissected in class; others appeared in examination questions. This was disconcerting to some students, who found it unorthodox to challenge the printed word. Since rejection of the method of authority is often taught as a feature of the scientific attitude, we feel that the technique was valuable.

It is realized that some will consider such techniques to be distractions from what the author or lecturer is trying to teach. Indeed, the whole matter may be dismissed as a disproportionate concern with words at the expense of course content. But what is the lecturer trying to teach? What should be the content of science courses which, usually, purport to satisfy the objectives of a liberal-arts curriculum? In view of the differences between the traditional content of physics and chemistry and biology, it seems unreasonable to claim that these different contents are equivalent for satisfying liberal-arts requirements. Rather, we should reexamine one of the platitudes—"teach them how to think." If this is what the lecturer hopes to teach, then an occasional distraction from the factual material is not only justified, it is essential.

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AAAS Special Sessions

One of the characteristic and most important features of the annual meetings of the Association is the series of outstanding general addresses by distinguished authorities, sponsored by organizations that meet regularly with the AAAS. These special events are joint sessions with the Association and are open to the general public of the city in which the meeting is held.

AAAS Presidential Address; 28 Dec., evening; Wallace R. Brode, science adviser, Department of State, and president of the AAAS, presiding. "Fifty years of medical genetics," by Laurence H. Snyder, president, University of Hawaii, and retiring president of the AAAS. Preceding the address, Leonard Carmichael, secretary of the Smithsonian Institution and general chairman of the Washington meeting, will speak briefly. Following the address there will be an informal AAAS presidential reception in the ballroom and adjacent rooms of the Sheraton-Park Hotel. All registrants and members of the local committees are cordially invited to attend.

Joint Annual Address of the Society of the Sigma Xi and the United Chapters of Phi Beta Kappa; 29 Dec., evening. "Science and public policy," James R. Killian, Jr., special assistant to the Presi-

AAAS Washington Meeting

Raymond L. Taylor

The preliminary announcement of the Seventh Washington Meeting [Science 127, 1246 (23 May 1958)], which will be held from 26-31 December, inclusive, has indicated the scope of the programs of the AAAS as a whole, the 18 sections, and of the nearly 100 participating organizations.

The synopses of the programs, which began to appear in Science with the 7 November issue and are concluded on page 1438, have provided additional information—but only the General Program-Directory, which will reach advance registrants by first-class mail in the next day or so, can furnish a full appreciation of the number and quality of the more than 300 sessions. The editorial on page 1391 points out a few of

the highlights. It is manifest that this year's 125th annual meeting of the Association will be particularly interesting and significant.

The Annual Exposition of Science and Industry, the largest and most varied in recent years; the unusual number of carefully selected, prize-winning foreign scientific films; the first demonstration of a new, much improved, closed-circuit, color television system; the special events for women—any one of these might make a visit to Washington worthwhile—merit special consideration. There are, however, programs of interest to specialists in all the principal disciplines, strong interdisciplinary symposia, and a number of programs of concern to all scientists. A conspectus of these events follows.

dent for science and technology. Wallace R. Brode, president, will represent the AAAS.

Annual Lecture and Film of the National Geographic Society; 30 Dec., evening. "Winter at the South Pole," Paul A. Siple, scientific adviser, Office of the Chief of Research and Development, U.S. Army. Paul E. Klopsteg, president-elect, will represent the AAAS.

Religious Events

Adas Israel Congregation, 27 Dec., morning. "Science as a tool for human betterment," Maurice Shapiro, U.S. Naval Research Laboratory.

Washington Cathedral, 28 Dec., morning. Guest sermon by Paul Johannes Tillich, Harvard University. A portion of the cathedral will be reserved until 10:50 for visiting scientists wearing the Convention Badge.

St. Matthew's Cathedral. Solemn High Mass, Most Reverend Patrick A. O'Boyle, Archbishop of Washington, presiding. "Ideals and Idols in Scientific Progress," Right Reverend Monsignor William J. McDonald, Catholic University of America.

Luncheon and Business Meeting of the Albertus Magnus Guild; 28 Dec., noon. Georgetown University School of Nursing dining room; Eugene M. K. Geiling, University of Chicago, presiding.

Washington Cathedral, 28 Dec., afternoon. Evensong and Musical Service; Seven Lessons and Carols.

AAAS General Symposium

At a joint meeting in the spring of 1956, the Committee on AAAS Meetings and the secretaries of the AAAS sections decided that at each AAAS annual meeting there should be one or more general sessions for the Association as a whole. The title "Moving Frontiers of Science" was adopted for these sessions, which consist of reports of research trends and findings of such broad nature that they are of concern to many branches of science.

Comparative Patterns of Scientific Organization. Part I, 26 Dec., evening. Wallace R. Brode will preside. "Organization of Scientific Activities in the United Kingdom," E. S. Hiscocks, director of the United Kingdom Scientific Mission, Washington, D.C.; "Organization of Scientific Activities in Norway," Robert Major, director, Royal Norwegian Council for Scientific and Industrial Research, Oslo. Part II, 27 Dec., afternoon. Wallace R. Brode will preside. "Organization of Scientific Activities in Canada," B. G. Ballard, vice president, National Research Council of Canada; "Comparisons with the Organization of

Scientific Activities in the United States, Don K. Price, dean, Graduate School of Public Administration, Harvard University; Discussion by participants.

AAAS General Sessions

Social Aspects of Science. The AAAS Committee on Social Aspects of Science was authorized at the New York Council Meeting of the AAAS in 1956. It grew out of an Interim Committee authorized the previous year, under the chairmanship of Ward Pigman of the University of Alabama Medical Center. Members of the committee are: Chauncey D. Leake, chairman; T. C. Byerly; Barry Commoner; H. Jack Geiger; Lawrence Kubie; Margaret Mead; Frank W. Noteboom; Ward Pigman; Stuart A. Rice; David Rutstein; Henry D. Smyth; J. J. Spengler; Wallace R. Brode, *ex officio*; Paul E. Klopsteg, *ex officio*; Laurence H. Snyder, *ex officio*; Dael Wolfe, *ex officio*.

"Perspectives in our National Medical Research Program," 27 Dec., morning. Symposium arranged by Chauncey D. Leake, who will preside. Speakers: Stanhope Bayne-Jones, U.S. Department of Health, Education, and Welfare; Francis Boyer, Smith, Kline & French Laboratories, Philadelphia, Pa.; Hugh H. Hussey, Georgetown University School of Medicine; Willard C. Rappleye, Josiah Macy Jr. Foundation, New York; James A. Shannon, National Institutes of Health.

Science and Mathematics. The AAAS Cooperative Committee on the Teaching of Science and Mathematics was established in 1941 by representatives of several scientific societies to work on educational problems whose solution can be obtained better by cooperative action than by any single scientific group working alone.

Session; 28 Dec., morning. J. W. Buchta, chairman of the committee, will preside. "Report of the Science Teaching Improvement Program and Future Plans," John R. Mayor, AAAS. Panel report, "Study on the Use of Science Counselors." Participants: Wayne Taylor; John A. Brown; Clarence Diebel; H. Seymour Fowler; John W. Gustad; Alan Humphreys; F. L. Nicolai; Oscar Schaaf; John Wagner.

Washington Academy of Sciences. Symposium: "Extramural Science Programs of the Federal Government"; arranged by a committee, George W. Irving, Jr., chairman; 28 Dec.; A. T. McPherson, National Bureau of Standards, presiding. Papers by Robert B. Brode, National Science Foundation; C. J. Van Slyke, National Institutes of Health; Byron T. Shaw, U.S. Department of Agriculture; George D. Lukes, U.S. Department of Defense; Charles L. Dunham, U.S. Atomic Energy Commissi-

sion; and Ira H. Abbott, National Aeronautics and Space Administration.

Academy Conference. Panel discussion: "The Academy Movement—Yesterday, Today, and Tomorrow"; 28 Dec.; A. M. Winchester, Stetson University, presiding. Papers by C. L. Baker, Southwestern College at Memphis; J. Teague Self, University of Oklahoma; Ralph W. Dexter, Kent State University; and Paul B. Sears, Yale University. Panel members, Foley F. Smith, Virginia Academy of Science; Robert C. Miller, California Academy of Sciences; E. Ruffin Jones, Jr., University of Florida; and Clarence Lindahl, Iowa State College.

Session on Junior Academies: 28 Dec.; Elmore Stoldt, Jacksonville, Ill., presiding. Paper by H. Neil Hardy, New Lenox, Ill., followed by a panel discussion: "Current Activities and Problems of Junior Academies of Science"; Robert C. Miller, moderator; panel members, Ted F. Andrews, Kansas State Teachers College; Harry J. Bennett, Louisiana State University; Clarence H. Lindahl; Clyde T. Reed, University of Tampa; Karlem Riess, Tulane University; and James A. Rutledge, University of Nebraska.

Dinner and presidential address: "A New Day for Science?" by John A. Yarbrough, Meredith College; 28 Dec.; Thelma C. Heatwole, presiding.

Twelfth Annual Junior Scientists Assembly. This year the Junior Scientists Assembly, sponsored by the Academy Conference, has invited many selected students from the Washington area, who are interested in science as a career, to a program especially planned for them. The program has been arranged by a committee under the chairmanship of Keith C. Johnson, department of science, District of Columbia Public Schools. There will be four panel discussions on science and mathematics education in college and high school; 29 and 30 Dec. Annual Christmas lectures by J. R. Zacharias, Massachusetts Institute of Technology: I, "The Size of Atoms," 29 Dec.; II, "The Pressure of Light," 30 Dec.

Color Television Programs

Closed-circuit color television on conventional receivers has been shown at various medical and other meetings for some years. A new, improved closed-circuit television system—featuring large screen projection with superior color and definition—will be demonstrated publicly for the first time at any scientific meeting, through the cooperation of CIBA Pharmaceutical Products, Inc.

Seven sections of the Association have collaborated on four 1-hour programs with teaching content as well as intrinsic

entertainment value. Those interested in the technical details of the "Ediphor" system, invented in 1939 and only recently perfected, may secure information at the CIBA booths in the Annual Exposition of Science and Industry.

Program I. 27 Dec., afternoon; jointly sponsored by AAAS Sections B-Physics, C-Chemistry, and E-Geology and Geography. Arranged by a committee, Deane B. Judd, National Bureau of Standards, chairman. Subjects covered: refraction of light; production of spectra; crystals; polarized light; fluorescence; color vision and color blindness; experiments with free radicals.

Program II. 28 Dec., afternoon; jointly sponsored by AAAS Sections F-Zoological Sciences and G-Botanical Sciences. Arranged by a subcommittee of the AIBS Committee on Education and Professional Recruitment, H. Burr Roney, University of Houston, chairman. Demonstration of Growth, Septation, and Cytoplasmic streaming in *Monilia (Neurospora) sitophila*, Carroll Cox, University of Maryland. A Survey of *Drosophila* Genetics, with Demonstrations of Salivary Gland Chromosome Preparation Technique, and Discussion of the Probable Relations between DNA, Nucleoprotein Structure, and Salivary Chromosomes, Lewis Levine, College of the City of New York. Demonstrations of Microsurgical Procedures on Protozoa, particularly *Stentor*: Examples of Induced Fission, Parabiotic Grafting, Nuclear Transplants, etc., Paul B. Weisz, Brown University.

Program III. 29 Dec., afternoon; sponsored by AAAS Section N-Medical Sciences. Arranged by the officers of the section and Andrew G. Morrow, National Heart Institute, Bethesda, Md. This program, supplemental to the section's symposium, is restricted to those with professional interests who have applied for, and received, a card of admission.

Program IV. 30 Dec., afternoon; sponsored by AAAS Section N-Medical Sciences. Arranged by the officers of the section and Andrew G. Morrow. This program, supplemental to the section's symposium, is restricted to those with professional interests who have applied for, and received, a card of admission.

AAAS Science Theatre

The AAAS Science Theatre, a permanent feature of the Association's annual meeting, presents each year a selection of the latest domestic and foreign scientific films at intervals throughout the meeting period. Admission is restricted to those who wear the Convention Badge. The Theatre will be in the Exhibit Hall of the Sheraton-Park Hotel. The Association is greatly indebted to

those who made and lent these films.

Hours of the Science Theatre: 27-28 Dec., 10 A.M. to 2 P.M. and 2 to 6 P.M.; 29 Dec., 9 A.M. to 1 P.M. and 1 to 5 P.M.; 30 Dec., 11 A.M. to 3 P.M.

Saturday Morning, 27 Dec.

Human Gastric Function. Presented by Smith Kline & French Laboratories,

Ultimate Structure. Produced by Philips Electronics.

Stimuli Releasing Sexual Behaviour of Domestic Turkeys. Produced by Martin Schein and E. B. Hale, Psychological Cinema Register, Pennsylvania State University.

Living in a Reversed World. Produced by Theodor Erisman and Ivo Konler, Department for Experimental Psychology, University of Innsbruck, Austria.

Mystery of Time. Produced by Moody Institute of Science.

High Energy Radiations for Mankind. Produced by High Voltage Engineering Corporation.

Dynamics of Phagocytosis: the Interaction between Group A Streptococci and Human Neutrophils in vitro. Produced by Leo L. Leveridge, Medical Film Department, Pfizer Laboratories, and Armine T. Wilson, Alfred I. duPont Institute, with Production Services by Campus Film Productions.

The Human Nose—What Makes It Different? Produced by Medical Film Guild.

The World of Microbes. Produced by Tokyo Cinema Co., Tokyo, Japan.

Saturday Afternoon, 27 Dec.

Comparative Micro-Cinematographic Study of Results Obtained in Tissue Culture Investigations: Positive Anoptral and Nomarski Interference Phase Contrast. Produced by Robineaux, Hospital Saint-Antoine, Paris, France.

Uranium. Produced by Films Division Government of India, Bombay.

Cycle of Life. Produced by Foundation Films and Science, University Films, Utrecht, Netherlands.

Analysis of Reactions between Antibodies and Living Cells. Produced by K. G. Moreman, E. T. Ambrose, G. C. Easty, and D. M. Easty, Chester Beatty Cancer Research Institute, London, England.

Trapped Free Radicals. Produced by National Bureau of Standards.

Paths of Steel. Produced by United States Steel Corporation.

Reaching for the Stars. Produced by Australian News and Information Film Division, Commonwealth Department of the Interior.

Our Sun in Action. Produced by Sacramento Peak Observatory of the Geophysics Research Directorate, Air Force Cambridge Research Center.

Music from Oil Drums. Produced by Toshi and Peter Seeger.

The Kinetics and Development of Embryonic Organs in vitro. Produced by E. Wolf, College de France, Paris.

Aero Medical Research. Produced by the U.S. Air Force.

Submarine Medicine. Produced by Medical Horizons, Ciba Pharmaceutical Products.

Sunday Morning, 28 Dec.

The Earth Is Born. Produced by Transfilm.

Egg Development and Metamorphosis of Calliphora Erythrocytes. Produced by Dr. Ing. Wolf, Institute für den Wissenschaftlichen Film, Göttingen, Germany.

Oil-Bearing Palm. Produced by Gerard de Boe, Watermael-Bruxelles.

Between the Tides. Produced by British Transport Films, London.

At the Doorstep toward Life. Produced by Veb-Defa Studio für Popularwissenschaftliche Film, Potsdam-Babelsberg, Germany.

Faster than Sound. Produced by Veb-Defa Studio für Popularwissenschaftliche Film.

Cradles. Produced by Studios Budapest, Hungary.

Sea Urchins. Produced by J. Painlevé and G. Hamon, Paris.

The Work of the Heart in the Sea-Trout Embryo. Produced by Office of Distribution of Films, Warsaw, Poland.

Ultrasonic Processes in Schlieren Studies. Produced by Institute für Mikrobiologie und Experimentelle Therapie, Jena, Germany.

Astronomical and Meteorological Phenomena. Institute of Geophysics Application, Academy of Sciences of the USSR, Moscow.

Biological Action of Ionising Radiation upon Microorganisms. Studio of Moscow of Science Films, Moscow.

Colorphotography. Produced by Veb-Defa Studio für Popularwissenschaftliche Film.

Sunday Afternoon, 28 Dec.
Same as Saturday morning, 27 Dec.

Monday Morning, 29 Dec.
Same as Saturday afternoon, 27 Dec.

Monday Afternoon, 29 Dec.
Same as Sunday morning, 28 Dec.

Tuesday, 30 Dec.

The World of Microbes.
Capillary Vessels in Surfaces of Skin and Organs. Produced by Dr. Ing. Wolf, Institute für den Wissenschaftlichen Film.

The Kinetics and Development of Embryonic Organs in vitro.

Dynamics of Phagocytosis: the Interaction between Group A Streptococci and Human Neutrophils in vitro.

The Earth Is Born.

Sea Urchins.

Between the Tides.

Glass. Produced by Ministry of Education, Arts, and Sciences, The Hague, Netherlands.

Lighting Systems in Microscopy. Produced by J. Dragesco, Paris, France.

Whooping Crane. Produced by Office of Information, U.S. Fish and Wildlife Service.

Symposia

Mathematics. "Mathematics in the Social Sciences"; "The Problem of Formulating a Problem"; "Adventures with Electronic Digital Computers."

Physics. "Reviews of Special Topics in Physics"; "Satellite Mechanics and Space Explorations"; "Upper Atmosphere Research and Reentry Mechanics"; "Space Vehicle Design"; "Guidance, Control, and Communications"; "Review of Recent Developments in Radar Meteorology"; "Numerical Weather Prediction."

Chemistry. "Kinetics of Gas Phase Reactions"; "Frozen Free Radicals" (two sessions); "Chemical Effects of High Energy Radiation" (three sessions); "Biochemical Studies of Schizophrenia."

Geology and Geography. "History of American Geology" (three sessions); "Experimental Geology"; "Geographic Research—Broadening Horizons"; "The Saint Lawrence Seaway."

Zoological Sciences. "Vertebrate Zoology" (four sessions); "Arthropod Physiology" (five sessions); "Linnaeus and Nomenclatorial Codes"; "Basic Concepts of Systematic Order"; "Systematics: Present and Future."

Biological Sciences. "Some Unsolved Problems in Biology, 1958: I, Plant and Animal Behavior; II, Differentiation"; "Integrative Mechanisms in Biology"; "Mathematical Models in Biology"; "Calcification in Biological Systems"; "Microbiology in Outer Space Research."

Botanical Sciences. "The Physiology of Algae."

Anthropology. "Anthropological Research in Government."

Psychology. "Early Experience and Imprinting"; "Psychopharmacology: Behavior Profiles and Drug Action"; "The Human as a Measuring Instrument"; "How Phylogenetically Older Parts of the Brain Relate to Behavior"; "The Future of Contemporary Learning Theories."

Social and Economic Sciences. "Major Problems of the American Economy"; "Research Problems in the Social Sciences" (two sessions); "Political Science Roundtable"; "Controversial Areas" in Twentieth Century Criminology" (four sessions); "Sociological Studies in Mental Disorder"; "Demographic and Sociological Aspects of Scientific Manpower"; "Statistical Methods in the 1960 Census"; "Some Developments in Statistical Economics."

History and Philosophy of Science. "Studies in Pre-Darwinian Evolution"; "Problems and Studies in 19th Century Science"; "Population Dynamics" (two sessions).

Engineering. "National and International Aspects of Systems of Units in Coordinated Disciplines of Science and Technology" (four sessions); "Photogrammetry in Science" (two sessions); "Instrumentation of Precision Measurements."

Medical Sciences. "Congenital Heart Disease" (four sessions); "Premedical and Predental Education"; "Man and His Environment in Space" (two sessions); "Hallucinations" (four sessions).

Pharmacy. "Hospital Pharmacist of the Future."

Agriculture. "Water and Agriculture" (four sessions).

Industrial Science. "Industrial Science Today."

Science in General. "Participation of Women in Science"; "Communicating Science in Translations"; "Communicating Science in Three Dimensions"; "Communicating Science in Specialized Libraries"; "The Employment Situation for Scientists and Engineers in 1959" (two sessions); "International Geophysical Year Results: I, Arctic and Antarctic; II, Rockets and Satellites; III, Meteorology, Oceanography, Glaciology" (three sessions).

Additional information on the programs planned in industrial science, education, and science in general is published on page 1438.

AAAS Business Sessions

The Board of Directors of the Association will meet in a private suite in the Sheraton-Park Hotel, at 9:30 A.M. Saturday, 27 Dec., and again at the same hour on Sunday, 28 Dec.

The Council of the Association will meet Saturday afternoon, 27 Dec., at 4 P.M., in the Continental room of the Sheraton-Park Hotel. A second session of the Council is scheduled for Tuesday morning, 30 Dec., at 9 A.M., in the same room. Subjects to be considered by the Council (in addition to the agenda prepared) usually are first brought before the Board of Directors through the Executive Officer. During the meeting, communications for the Board of Directors should be submitted in writing and left at the mail desk of the Sheraton-Park Hotel. They should be addressed to Dael Wolfe.

There will be a joint luncheon and business meeting of all Section Officers and the Committee on AAAS Meetings on Tuesday, 30 Dec., at 12:30 P.M. in a private suite at the Sheraton-Park Hotel. Dael Wolfe and Raymond L. Taylor, cochairs.

Hotel Headquarters

The Sheraton-Park Hotel is the official headquarters of the AAAS; it is where the Council of the Association will meet and where other business sessions will be held. The Press Room—for receipt of authors' abstracts and the only source of press releases—is in the Franklin Room just off the lobby.

The Main Registration-Information Center, the Visible Directory of Registrants, the AAAS Office, the AAAS Science Theatre, and the Annual Exposition of Science and Industry are also all in the Sheraton-Park Hotel.

The headquarters of the 18 sections and 93 participating societies appeared in *Science*, 18 July.

Registration

Main Registration-Information Center. The AAAS Main Registration-Information Center is located in the lobby of the Sheraton-Park Hotel. It will be open as follows: 26 Dec., 9 A.M. to 9 P.M.; 27-30 Dec., 8 A.M. to 8 P.M., with the exception of Monday, 29 Dec., when it will remain open till 11 P.M. to accommodate nonregistrants who wish to attend the AAAS Smoker, and Tuesday, 30 Dec., when it will close at 6 P.M.

Badges and General Programs may also be obtained at the supplementary registration desks, but supplementary literature, maps, and the like will be available only at the Main Registration Center. Advance registrants (who have received programs and badges prior to the meeting) are urged to visit the Main Registration Center at any convenient time to obtain these items.

Supplementary Registration Desks. For the convenience of those attending the 125th meeting, there are four supplementary hotel registration desks, as follows: Shoreham, 26 Dec., 10 A.M. to 9 P.M.; 27 Dec., 8 A.M. to 8 P.M.; 28 Dec., 9 A.M. to 5 P.M.; Statler, 26 Dec., 1 P.M. to 9 P.M.; 27 Dec., 8 A.M. to 8 P.M.; 28 Dec., 9 A.M. to 8 P.M.; 29 Dec., 9 A.M. to 5 P.M. Willard, 27 Dec., 1 P.M. to 9 P.M.; 28 Dec., 8 A.M. to 8 P.M.; 29 Dec., 8 A.M. to 6 P.M. Dupont Plaza, 28 Dec., 9 A.M. to 8 P.M.; 29 Dec., 8 A.M. to 6 P.M.

Guests at the Washington Hotel will find the Willard convenient for registration; guests at the Roosevelt or Windsor Park should register at the Sheraton-Park; guests at the Sheraton-Carlton will find the Statler convenient.

Registration Fee. The AAAS registration fee, which, intentionally, has been kept at a minimum, is \$3 for all; a spouse or child not wishing a separate program may register for \$1, if registering at the same time. Each registrant receives a receipt, a Convention Badge, and the Gen-

eral Program-Directory—the only publication with the programs of the 18 AAAS Sections and of the 92 participating organizations. Any person who purchases an advance copy of the General Program-Directory but does not register in advance, and who then attends the meeting, has agreed to complete his registration—and is expected to do so—at the Main Registration Center, or at one of the four supplementary registration desks, after which he will receive his Convention Badge and the privileges that go with it.

AAAS Convention Badge. Every thoughtful person will wish to register and thus pay his share of the expenses of the meeting. The AAAS Convention Badge indicates that you are a complete participant in this 125th Convention of the Association. The badge should be worn throughout the meeting because it reminds others to register; it is needed for admission to the AAAS Science Theatre, the AAAS Smoker, and the reception that follows the presidential address; and it helps your friends to find you.

Visible Directory of Registrants. The Visible Directory of Registrants, for the maximum convenience of all, is located in the foyer near the Annual Exposition of Science and Industry. It is open at all times. The registration cards of all registrants are placed in the Visible Directory as soon as possible after registration. The arrangement is alphabetical. The cards of advance registrants are completely alphabetized and typed since they are posted in Washington prior to the meeting; all other registration cards are filed to the second or third letter of the surname (*Ba, Be*, and so forth). Members of the press, exhibitor personnel, and guests are included in the Visible Directory—on blue cards instead of yellow. Registrants will find the Visible Directory invaluable in determining the convention addresses of friends attending the meeting.

Mail, Telegrams, and Messages. Mail and telegrams addressed in care of the AAAS will be held at the AAAS Office in the Madison suite, off the lobby of the Sheraton-Park. Efforts will be made to notify addressees listed in the Visible Directory, but the Association assumes no responsibility for the delivery of mail or of telegrams. Telephone and personal messages will be filed alphabetically in the AAAS office, and the names of those for whom they are intended will be posted on a bulletin board.

Society Meal Function Tickets. Tickets to the dinners or luncheons of any participating society are obtainable only from representatives of that society, either during preceding sessions of that society, at the AAAS Information Center, or at supplementary Registration Desks.

Special Events for Women

Several special events for women have been arranged by the Committee on Women's Events (Mrs. Allen T. Waterman, *chairman*).

Registration. Be sure to register—or to have your husband register for you—and to get your Convention Badge.

Women's Information Center. This is located near the Main Registration in the lobby of the Sheraton-Park Hotel. Here you can find information and literature describing the events planned for the wives of members. Buy your ticket for the Ladies' Luncheon here.

Coffee Hour: 9:30 to 11 A.M., Friday and Saturday, 26 and 27 Dec., near the Information Center at the Sheraton-Park. No charge for the coffee.

Sunday, 28 Dec. Note the special service at Washington Cathedral at 11 A.M. and other services described under "Religious Events."

Monday, 29 Dec., 10 A.M. Special introduction to the Smithsonian Institution, at the Natural History Building at 10th Street and Constitution Avenue, in the auditorium. Leonard Carmichael, secretary of the Smithsonian Institution and general chairman of this meeting of the AAAS, will welcome the wives of members to Washington and to the Smithsonian. Tour of the institution. The Information Center has a list of places near the Smithsonian for lunch or tea.

Tuesday, 30 Dec., 9:20 A.M. Special tour of the White House, arranged by the White House staff. Children may accompany their parents. Be at the East Gate promptly. You must wear your registration badge. No charge.

Tuesday, 30 Dec., 12:45 P.M. Ladies' luncheon in the Palladian room of the Shoreham Hotel. Price \$3.50. Tickets will be on sale at the Women's Information Center at the Sheraton-Park and in the lounge during the coffee hour. We cannot promise that there will be tickets available at the door at the time of the luncheon. Margaret Mead, associate curator of ethnology for the American Museum of Natural History and member of the AAAS Board of Directors, will speak on "On Bringing up Children in the Space Age."

Local Travel Directions

At this 125th meeting, the hotels used are all on the same bus line. Thus, almost all the sessions in their numerous public rooms are not inconveniently far from each other. For the convenience of the attendance, the D. C. Transit System plans augmented bus service on the regular L route between the downtown hotels and the Shoreham and Sheraton-Park hotels. For those who prefer other

transportation, however, taxis are available. Taxis are moderate.

From the Willard and Washington hotels to the Shoreham and Sheraton-Park: at 13th Street and Pennsylvania Avenue, take an L2 bus (marked Connecticut and Nebraska) or an L4 bus (marked Chevy Chase Circle). Get off at Calvert Street for the Shoreham, at Woodley Road for the Sheraton-Park.

From the Statler and Sheraton-Carlton hotels: Take the L2 or L4 bus at 16th and I Streets.

From the Dupont Plaza Hotel: Take the L2 bus at 18th and P Streets.

To the downtown hotels from the Sheraton-Park and Carlton: Take the L2 or L4 bus (both marked Federal Triangle).

Tours and Points of Interest

At this meeting, there will be no formal tours sponsored by the AAAS as a whole, but certain sections and participating societies have planned tours and field trips.

The brochure, "Welcome to Washington," which all registrants should receive, includes a map of the city and a keyed list of the points of interest. The following are of special interest.

AAAS Headquarters Building (1515 Massachusetts Ave., NW). Open 9 A.M. to 6 P.M., except Saturday, 27 Dec., when it will be open until 9 P.M.

Corcoran Gallery of Art (17th St. and New York Ave., NW). Open weekdays 10 A.M. to 4:30 P.M.; Sunday 2 to 5 P.M.

Freer Art Gallery (12th St. and Independence Ave., SW). Open daily 9 A.M. to 4:30 P.M.

National Geographic Society (16th and M Sts., NW). Open Monday through Friday 9 A.M. to 4:30 P.M.

National Education Headquarters Building (16th and M Sts., NW). Open Monday through Friday 8:15 A.M. to 5 P.M.

National Gallery of Art (Constitution Ave., between 4th and 7th Sts., NW). Open week days 10 A.M. to 5 P.M.; Sunday 2 P.M. to 10 P.M.

Phillips Gallery of Art (Massachusetts Ave. and 21st St., NW). Open Monday 11 A.M. to 10 P.M.; Tuesday through Saturday 11 A.M. to 6 P.M.; Sunday 2 to 7 P.M.

Smithsonian Institution (The Mall, between 9th and 12th Sts., NW). Open daily 9 A.M. to 4:30 P.M.

U.S. National Museum (Constitution Ave. and 10th St., NW). Open daily 9 A.M. to 4:30 P.M.

Washington Cathedral (Wisconsin and Massachusetts Aves., NW). Open weekdays 9 A.M. to 6 P.M. There will be a special "Science Sunday" service at 11 A.M., followed by a special tour for AAAS registrants.

AAAS Public Information Service

The necessity for the general public to be kept informed whenever feasible of the results of the scientific research and development which it supports, directly or indirectly, is evident. Organized science and the individual scientist must have the understanding and support of intelligent citizens in all walks of life if they are to contribute effectively to the over-all advance of American democracy. It is, of course, equally important that information for the public concerning advances in science be clearly and accurately disseminated and without sensationalism. Progress in this direction in recent years has been in most instances outstanding, thanks largely to members of the National Association of Science Writers, other accredited science reporters, managing editors of American newspapers, and program managers of radio and television stations.

One of the four objectives of the AAAS is to try to increase public understanding and appreciation of the importance and promise of the methods of science in human progress. For this reason, and to protect authors of papers from being misquoted by the press, the Association maintains a public information service for each of its annual meetings. Sidney S. Negus, Medical College of Virginia, Richmond, Virginia, has been director of this service for most meetings since 1938. He will have written to each author on the 1958 program prior to publication of the General Program-Directory asking his cooperation.

During the meeting, it is in the interest of accuracy and completeness that science writers frequently wish to discuss various research results with investigators. If you are asked to cooperate in this respect or to participate in a press conference, please do so—not only for your own protection but for the benefit of science in general. Scores of science writers will be covering this great scientific convention from the Pressroom in the Sheraton-Park Hotel. News stories filed by them will be published and broadcast throughout the world. The assistance of authors in helping to make them accurate is earnestly solicited by the AAAS.

This year the AAAS is fortunate not only in the continued services of Dr. Negus, but also in the services of its Local Committee on Public Information, composed of 17 members and headed by Windsor P. Booth, chief of the News Service, National Geographic Society.

Washington Committees

As is rather generally recognized, it would be quite impossible to successfully arrange a large and complex meeting and to carry it through to a conclusion, suc-

cessful in all respects, if it were not for the devoted services of many local scientists and other members and friends of the Association. They merit the unstinted appreciation of all who attend. It is noteworthy that Leonard Carmichael accepted the general chairmanship of the Washington meeting without delay, appointed the local committees promptly, and has kept in close touch with all phases of this year's meeting.

General Chairman

Leonard Carmichael, secretary, Smithsonian Institution.

Committee on Exhibits

R. Roy Dunn, president, Potomac Electric Power Company, *chairman*.

Donald S. Bittinger, president, Washington Gas Light Company.

R. S. Bouteille, president, Fairchild Engine and Airplane Corporation, Hagerstown, Md.

R. E. Gibson, director, Applied Physics Laboratory, Johns Hopkins University, Silver Spring, Md.

Marshall G. Holloway, president, Nuclear Products-Erco Division of ACF Industries, Inc., Riverdale, Md.

J. W. Howard, vice president, Virginia Electric and Power Company, Alexandria, Va.

Carl J. Knorr, vice president, Remington Rand.

Daniel P. Loomis, president, Association of American Railroads.

F. G. Macarow, vice president-operations, C & P Telephone Companies.

Austin E. Penn, executive vice president, Baltimore Gas and Electric Company, Baltimore, Md.

G. S. Trimble, Jr., vice president-engineering, the Martin Company, Baltimore, Md.

C. Swan Weber, vice president, Westinghouse Electric Corporation.

N. L. Whitecotton, regional vice president, General Electric Company, Philadelphia, Pa.

J. R. O'Hanlon, Potomac Electric Power Company, *Assistant to chairman*.

Committee on Finance

Daniel W. Bell, president and chairman, board of directors, American Security & Trust Company, *chairman*.

H. K. Beck, commercial vice president, Worthington Corporation.

Everett J. Boothby, chairman of the board, Washington Gas Light Company.

Robert V. Fleming, chairman, board of directors, Riggs National Bank.

Warren R. Forster, president, D. C. Bankers Association.

Francis J. Kane, president, Merchants & Manufacturers Association.

J. B. Morrison, president, Chesapeake and Potomac Telephone Company.

Victor O. Schinnerer, president, Washington Board of Trade.

Committee on Physical Arrangements

Lawson J. Cantrell, deputy superintendent, District of Columbia Public Schools, *chairman*.

Richard A. Banks, teacher of science, Stuart Junior High School.

Langston Bate, professor of science, District of Columbia Teachers College.

Mrs. Inez R. Browne, supervisor, Visual Education Department, District of Columbia Public Schools.

Harold Clark, director, Visual Education Department, District of Columbia Public Schools.

Walter Griest, teacher of science, Paul Junior High School.

Elgy S. Johnson, teacher of mathematics, Spingarn High School.

Keith Johnson, supervising director of science, District of Columbia Public Schools.

Thomas Sheehan, Visual Education Department, District of Columbia Public Schools.

Mrs. Laverne Walker, director of curriculum, Visual Education Department, District of Columbia Public Schools.

Committee on Public Information

Windsor P. Booth, chief, News Service, National Geographic Society, *chairman*.

Jules B. Billard, *U.S. News and World Report*.

Walter T. Bonney, National Aeronautics and Space Administration.

Watson Davis, director, Science Service.

Julius Frandsen, Jr., United Press International.

Julian Goodman, National Broadcasting Company News.

Miss Ella Harllee, director, Radio and Television Programs, Council of Churches of the National Capital Area.

William M. Hines, Jr., the *Evening Star*.

Robert F. Hurleigh, Mutual Broadcasting System.

George W. Irving, Jr., U.S. Department of Agriculture.

Theodore Koop, Columbia Broadcasting System News, Washington, D.C.

Matt McDade, National Geographic Society.

Miss Alyce M. Moran, Time, Inc.

Paul H. Oehser, chief, Editorial and Publications Division, Smithsonian Institution.

John H. Secondari, chief, News Bureau, American Broadcasting Company.

John Troan, Scripps-Howard News-papier Alliance.

Theodore Wiprud, executive director and secretary, Medical Society of the District of Columbia.

Committee on Women's Events

Mrs. Alan T. Waterman, *chairman*.

Mrs. Hurst R. Anderson.

Mrs. Wallace W. Atwood, Jr.

Mrs. Wallace R. Brode.
Mrs. Leonard Carmichael.
Mrs. Frank M. Setzler.
Mrs. Dael Wolfe.

Honorary Reception Committee

Leonard Carmichael, secretary, Smithsonian Institution, *chairman*.

Arthur S. Adams, president, American Council on Education.

Hurst R. Anderson, president, American University.

Justin M. Andrews, director, National Institute of Allergy and Infectious Diseases.

Marling J. Ankeny, director, Bureau of Mines.

F. A. Arnold, director, National Institute of Dental Research.

Allen V. Astin, director, National Bureau of Standards.

Pearce Bailey, director, National Institute of Neurological Diseases and Blindness.

George M. Beam, executive secretary, Association of Military Surgeons of the United States.

Rawson Bennett, chief, Office of Naval Research.

Howard L. Bevis, chairman, National Committee for the Development of Scientists and Engineers.

Carl Billman, secretary, United Chapters of Phi Beta Kappa.

Helen D. Bragdon, general director, American Association of University Women.

Wallace R. Brode, science advisor, Department of State.

Detlev W. Bronk, president, National Academy of Sciences.

Edward B. Bunn, president, Georgetown University.

Robert W. Burgess, director, Bureau of the Census.

Leroy E. Burney, surgeon general, U.S. Public Health Service.

T. C. Byerly, deputy administrator, Agricultural Research Service and Director of Farm Research.

Robert D. Calkins, president, Brookings Institution.

Paul O. Carr, president, District of Columbia Teachers College.

William G. Carr, executive secretary, National Education Association.

Carl G. Christie, superintendent, Naval Observatory.

Henry Clepper, executive secretary, Society of American Foresters.

Harold J. Coolidge, executive secretary, Pacific Science Board, National Research Council.

Thomas F. Cooper, commanding officer, National Naval Medical Center.

S. Douglas Cornell, executive officer, National Research Council.

Hiden T. Cox, executive director, American Institute of Biological Sciences.

Floyd S. Daft, director, National In-

stitute of Arthritis and Metabolic Diseases.

Lawrence G. Derthick, commissioner, Office of Education.

Wilbur A. Dexheimer, commissioner, Bureau of Reclamation.

Theodore A. Distler, executive director, Association of American Colleges.

Hugh L. Dryden, deputy administrator, National Aeronautics and Space Administration.

Wilson H. Elkins, president, University of Maryland.

Leonard M. Elstad, president, Gallaudet College.

Alden H. Emery, executive secretary, American Chemical Society.

Robert H. Felix, director, National Institute of Mental Health.

William P. Fidler, general secretary, American Association of University Professors.

Robert P. Fischelis, secretary, American Pharmaceutical Association.

Arthur S. Flemming, secretary, Department of Health, Education, and Welfare.

Arch C. Gerlach, secretary, Association of American Geographers.

Ralph E. Gibson, director, Applied Physics Laboratory, Johns Hopkins University.

T. Keith Glennan, administrator, National Aeronautics and Space Administration.

Gilbert Grosvenor, chairman of the board, National Geographic Society.

Melville Bell Grosvenor, president, National Geographic Society.

Wayne C. Grover, archivist of the United States, National Archives and Records Service.

Alfred M. Gruenthal, president, American National Red Cross.

Carl F. Hansen, superintendent, District of Columbia Public Schools.

Caryl P. Haskins, president, Carnegie Institution of Washington.

Silas B. Hays, surgeon general, Department of the Army.

Leonard Dudley Heaton, commanding general, Walter Reed Army Medical Center.

J. R. Heller, director, National Cancer Institute.

Bartholomew W. Hogan, chief of Bureau of Medicine and Surgery, and surgeon general, Department of the Navy.

John B. Holden, director, U.S. Department of Agriculture Graduate School.

Peter H. Horn, director, Naval Research Laboratory.

Mildred Horton, executive secretary, American Home Economics Association.

Mordecai W. Johnson, president, Howard University.

Joseph Kaplan, chairman, U.S. National Committee for the International Geophysical Year, National Academy of Sciences.

H. Arnold Karo, director, U.S. Coast and Geodetic Survey.

A. Remington Kellogg, assistant secretary, Smithsonian Institution and director, U.S. National Museum.

James R. Killian, Jr., special assistant to the President for Science and Technology.

Evron M. Kirkpatrick, executive director, American Political Science Association.

George P. Larrick, commissioner, Food and Drug Administration.

Milton O. Lee, secretary, Federation of American Societies for Experimental Biology.

Ladislaus Marton, president, Washington Philosophical Society.

Cloyd Heck Marvin, president, George Washington University.

Richard E. McArdle, chief, Forest Service.

John A. McCone, chairman, Atomic Energy Commission.

Charles P. McCurdy, Jr., executive secretary, State Universities Association.

William J. McDonald, rector, Catholic University of America.

Robert E. McLaughlin, president, Board of Commissioners, District of Columbia.

A. T. McPherson, president, Washington Academy of Sciences.

Howard A. Meyerhoff, executive director, Scientific Manpower Commission.

L. Quincy Mumford, librarian of Congress, Library of Congress.

George W. Mundy, commandant, Industrial College of the Armed Forces.

Thomas B. Nolan, director, U.S. Geological Survey.

Winfred Overholser, superintendent, Saint Elizabeths Hospital.

C. E. Palmer, secretary, American Society of Photogrammetry.

Theodore H. Reed, director, National Zoological Park.

Francis W. Reichelderfer, chief, Weather Bureau.

Stuart A. Rice, American Statistical Association.

Paul H. Robbins, secretary, National Society of Professional Engineers.

Frank H. H. Roberts, Jr., director, Bureau of American Ethnology.

Frank B. Rogers, director, National Library of Medicine.

Roger W. Russell, executive secretary, American Psychological Association.

Boyd C. Shafer, executive secretary, American Historical Association.

James A. Shannon, director, National Institutes of Health.

Byron T. Shaw, administrator, Agricultural Research Service.

William Silliphant, director, Armed Forces Pathology Laboratory.

Henry T. Skinner, director, National Arboretum.

Albert C. Smith, director, Museum of Natural History.

Waldo E. Smith, executive secretary, American Geophysical Union.

Robert C. Stephenson, executive director, American Geological Institute.

Arnie J. Suomela, commissioner, Fish and Wildlife Service.

Amos E. Taylor, chairman, National Academy of Economics and Political Science.

Frank A. Taylor, director, Museum of History and Technology, Smithsonian Institution.

Russell I. Thackrey, executive secretary, American Association of Land Grant Colleges and State Universities.

Alan T. Waterman, director, National Science Foundation.

Robert C. Watson, commissioner, U.S. Patent Office.

James Watt, director, National Heart Institute.

J. F. Wellemeier, executive associate, Washington Office, American Council of Learned Societies.

Donald A. Williams, administrator, Soil Conservation Service.

Conrad L. Wirth, director, National Park Service.

Dael Wolfe, executive officer, American Association for the Advancement of Science.

Annual Exposition of Science and Industry

The large-scale AAAS Annual Exposition of Science and Industry will be located in the Exhibit Hall of the Sheraton-Park Hotel. The exposition will be open to (i) all registrants who attend the meeting and (ii) interested adults who have applied for, and received, complimentary tickets of admission. The hours of the exposition are as follows: Friday, 26 Dec., 7 to 10 P.M.; Saturday, 27 Dec., 10 A.M. to 6 P.M.; Sunday, 28 Dec., 10 A.M. to 6 P.M.; Monday, 29 Dec., 9 A.M. to 5 P.M. and 8 to 10 P.M.; Tuesday, 30 Dec., 10 A.M. to 4 P.M.

AAAS New Member Service— Science, AAAS Publications

Booth 67. Whether or not one is a member of the American Association for the Advancement of Science, every person attending this meeting is cordially invited to visit the AAAS booth for information concerning the Association and its activities. Beyond the satisfaction of strengthening its work for science, for scientists, and for society by one's membership, there are demonstrable personal advantages in joining the Association.

Since its founding, in 1848, the Association has admitted to membership not only professional scientists but also other men and women who have a general interest in science, who wish to keep informed of the progress of science, and

who would like to support the high purposes of the one organization that represents all science. The New Member Service will be pleased to accommodate those who wish to join the Association as of 1 January. Those already members conveniently can nominate others for membership.

Included in the annual dues of \$8.50 (for 1959), each member receives the new, enlarged *Science*—the scientific newsweekly, which has the content of the former *Scientific Monthly* combined with it. Free sample copies will be distributed, and all not familiar with this leading journal of science should visit this booth, where symposium volumes and AAAS membership insignia are also on display. Prospective advertisers may obtain sample copies of the magazine and the rate card.

AAAS-Traveling High School Science Libraries

Booths 96 and 97. The AAAS administers this experimental traveling library program at the request of and with the financial support of the National Science Foundation. The exhibit consists of the 200 books comprising the library which is being circulated to over 1350 senior high schools representing every state and territory. Well-read high-school students will be at the exhibit to discuss the books. The program's objectives are to interest young people in science, to assist those with an aptitude in science in the choice of a scientific career, and to demonstrate the kinds of books that should be purchased by high-school and community libraries in order to satisfy the interests of young people and non-specialist adults. An annotated list of the books in the library may be purchased for 25 cents, and a selected list of paper-bound science books is available for 25 cents.

Now in its fourth year of operation, the program has proved that it is fulfilling its objectives, and hundreds of school and community libraries are basing their new acquisitions on the list of books. Institutes for high-school teachers sponsored by the National Science Foundation and special summer workshops for promising high-school students are using the traveling library books for collateral reading.

Addison-Wesley Publishing Company, Inc.

Booth 44. Addison-Wesley will display selected science and engineering books on the undergraduate and graduate level. The exhibit will feature the Atoms-for-Peace books which Addison-Wesley published on 1 September in conjunction with the Atomic Energy Commission for distribution to the official delegates at the Geneva Conference. Of particular interest to both the scientist and the in-

formed layman will be *Project Sherwood—The U.S. Program in Controlled Fusion* by Amasa Bishop. As part of the Atoms-for-Peace project, Dr. Bishop's book is the first unclassified treatment of our program in controlled fusion.

Other significant publications in the Addison-Wesley exhibit will include: *Radiation Biology and Medicine*, by W. D. Claus; *U.S. Research Reactor Operation and Use*, by J. W. Chastain, Jr.; *Uranium Ore Processing*, by J. W. Clegg and D. D. Foley; *Thorium Production Technology*, by F. L. Cuthbert; *Solid Fuel Reactors*, by J. R. Dietrich and W. H. Zinn; *Physical Metallurgy of Uranium*, by A. N. Holden; *Boiling Water Reactors*, by A. W. Kramer; *Fluid Fuel Reactors*, by J. A. Lane, H. G. MacPherson, and Frank Maslan; *The Transuranium Elements*, by Glenn T. Seaborg; *Sodium Graphite Reactors*, by C. Starr and R. W. Dickinson; and *The Shippingport Pressurized Water Reactor*, by personnel of the Naval Reactors Branch, Division of Reactor Development, U.S. Atomic Energy Commission. In addition to publications with strong reference potential, Addison-Wesley will also make available several titles which are primarily intended for texts.

Aerojet-General Corporation

Booth 63. The Aerojet-General display is a 10-ft exhibit. Featured in it are authentic models of 14 missiles which form an integral part of today's defense inventory. The models include: Bomark, Hawk, Polaris, Genie, Sparrow III, Regulus II, Bullpup, Vanguard, Aerobee-Hi, and Thor-Able, as well as the Titan, the Tartar, and the Minute Man. Because of security reasons the three last-named models are shrouded. The models are approximately 14 inches in height and represent the best efforts of West Coast aircraft industries model makers. In addition to the models there is a 4½-minute color, sound motion picture. The picture describes many of Aerojet's efforts in participating in the national defense program. Where possible, these efforts as portrayed in the movie are related to the models on display. For example, the movie points out that Aerojet did the facilities work in connection with the Thor-Able launching pads and the booster power plant for the Bomark.

The color scheme for the display is striking in its simplicity; the models are gray with red trim and are backlit with blue and white lights. The main panels are black.

American National Red Cross

Booth 35. This booth will feature the blood program potential exhibit. By means of art work, moving chart, and lighting, the exhibit illustrates the scope of the Red Cross regional blood centers,

the activities of a typical center, and a series of graphs in an automatic machine. These graphs illustrate the current and potential community values of blood and its derivatives.

American Sterilizer Company

Booths 16 and 17. The American Sterilizer Company will exhibit the American Flexible Film Isolator, the simplified apparatus for germ-free life techniques. This unit is economical and easy to use, maintains sterile environment, provides complete visibility, and cannot develop negative pressure. Also to be exhibited will be the American "Biogen" unit for continuous culture of microorganisms in large quantities—"Biogen" is a completely new apparatus which produces extremely large quantities of specific microorganisms quickly, economically, and continuously, under well-defined conditions. In addition, the American Sterilizer Company will exhibit a piece of equipment to be used under negative pressures for Dry Box procedures, including dust-free atmosphere, low-intensity radiation containment, microbiological procedures, radio chemistry, and toxic chemicals.

Association of American Railroads

Booths 12 and 13. The exhibit of the Association of American Railroads, "Flanged Wheels . . . Steel Rails"—"The Railroad Story" consists of a series of five illuminated panels tracing the growth and development of railroad transportation in the United States from its conception in 1830 to the present time. Against colorful, scenic backgrounds depicting life characteristic of America in 1830, 1860, 1880, 1920, and today, technological improvements and innovations are listed and identified with the historic period in which they were introduced or with which their use is particularly associated. These improvements include the early steam locomotive, the T-rail, flanged wheels, the coal-burning locomotive, standard gauge, the standardization of rules and time, brakes, couplers, and the modern Diesel locomotive, centralized traffic control, and electronic hump yards. A sixth panel graphically indicates how this development which has contributed so significantly to greater railroad operating efficiency has resulted in ever-decreasing average costs for the movement of freight.

Association of American University Presses

Booth 40. Each university press represented in the exhibit is a separate publishing house. This joint exhibit enables you to see books from a number of presses and, if you so desire, to order them. A free checklist of the books on display is available at the booth.

Basic Books—Library of Science

Booth 29. All areas of science are represented in the Basic Books display. Among recent publications are *Moments of Discovery*, a two-volume anthology of science writings; *Frontiers in Science*—a product of the California Institute of Technology; *Anatomist at Large*, by George W. Corner; *The Earth and Its Atmosphere*; and a new edition of Darlington's *Evolution of Genetic Systems*.

Basic Books' Library of Science division—also included in the display—distributes scientific books of all publishers to a membership that now reaches nearly 45,000. Among the authors of recent selections are Fred Hoyle, Niels Bohr, Werner Heisenberg, Giorgio Abetti, Milton K. Munitz, R. E. Peierls, John R. Pierce, Max Jammer, and Morris Kline.

Bell Telephone System

Booths 47, 48, 49, and 50. "Progress in Communications through Bell System Science." The vital part of the Bell Telephone System in defense of our nation and the importance of Bell Telephone Laboratories' research in keeping this nation's telephone service the most advanced on earth are stressed in exhibits scheduled for use at the Annual Exposition of Science and Industry, 26-30 Dec., in Washington, D.C.

The exhibits demonstrate Direct Distance Dialing and new express and bypass routes that insure continuity of communications in time of disaster. It is explained that this modern flexible communications system is a product of telephone research and that, as the research continues, the system will constantly improve. Four exhibits are devoted to projects currently under way at Bell Telephone Laboratories. They are: Research in Semiconductors, Research in Transmission, Research in Electronic Switching, Research applied to T.A.S.I.

T.A.S.I. (Time Assignment Speech Interpolation) is a new system that will double the capacity of the transatlantic telephone cable.

Biological Abstracts

Booth 59. A cooperative, nonprofit enterprise published by biologists for biologists. The exhibit will feature a more complete coverage of the biological literature, and many other improvements, to make this abstracting and indexing service even more useful and valuable to biologists than ever before. The tremendous increase in the volume of research papers published in thousands of journals throughout the world presents a challenge to *Biological Abstracts* and all biologists. If its position as the outstanding service in the biological sciences is to be maintained, the help of more biologists who are willing to take an active part in abstracting the vast number of

significant contributions that are appearing in print month after month must be enlisted. Only through the full cooperation of biologists themselves can the ambitious program for *Biological Abstracts* be carried out. Representatives will be on hand to welcome visitors, answer questions, and solicit volunteer collaborators.

Brinkman Instruments, Inc.

Booths 60 and 61. Most items on display this year are innovations which have been introduced during the past few months. Some new developments in microscopy are automatic camera microscopes, both for 4 x 5 and 30-mm negative sizes. These microscopes have a built-in exposure meter which is coupled with a shutter so that, by simply pressing a button, the exposure is made correctly and all guesswork is eliminated.

Also on display will be a series of precision-built Ultra Thermostats for temperature control and Jumo Contact Thermometers, which are widely used in temperature-control equipment both in the low and high ranges. New models of Brinkmann Manipulators especially for low-power work will be on display, also a micro capillary pH electrode for blood and other liquids available only in small quantities. The recently introduced Mettler Polarecord, a desk-type recording polarograph of extremely compact design, will also be on display.

Cambridge University Press

Booth 1. Cambridge University Press has long been a leading publisher in the natural and physical sciences—chemistry, physics, mathematics, biology, botany, zoology. It lists among its authors some of the world's most distinguished scientists including Sir Arthur Eddington, Sir James Jeans, George Gamow, Lord Rutherford, Bertrand Russell, A. N. Whitehead, and Sir Charles Sherrington.

Canal Industrial Corporation

Booth 83. CANALCO offers this year a complete new line of research instruments with applications in biochemistry, cytology, histology, and industrial physics and chemistry. In optics, CANALCO features the new Hi-intensity Fluxlamp and Trinocular Block, to permit microphotography and projection of light-microscope images at any magnification level. In analytical equipment: (i) the Europelec Micro-Densitometer for quick, accurate size and density measurements and quantitative analysis of organic and inorganic microscope specimens and microphotographic negatives; (ii) the Super-Sensitive Meter-Timer of great versatility, capable of measuring light intensity as low as 10^{-6} lumen and timing exposures from 0.1 to 1 minute, for use in microphotography, absorption and

flame photometry, fluorescence trace analysis, scintillation measurements, and so on; (iii) the Ultra-Violet Fraction Analyzer, for automatic identification and strip-recording of UV-sensitive fractions, an accessory for all standard makes of fraction collector; (iv) the Constant-Voltage Power Source of all battery-powered spectrophotometers to assure drift-free accuracy.

For processing, it features (i) the "Slow-Freeze" unit for automatic freeze-preserving of biological materials in the viable state—of particular use in preservation and storage of tissue cultures, bone marrow, blood products, and tissue for surgical transplant; (ii) the "Spherical-Trap" Freeze Dry unit for preparation of superior tissue specimens for morphological and histochemical studies. For electron microscopy it offers a complete line of accessories and test equipment for electron microscopes.

Carolina Biological Supply Company

Booth 4. Carolina Biological Supply Company takes this opportunity to invite all biologists to chat with our professional staff and to view our latest developments. The exhibit will include the first showing of our new 100-cubic-centimeter culture dish, together with the two popular larger sizes. Several cases of the dishes will be available, in order to demonstrate their quality of controlled stacking. Many other new materials, encompassing the field of biology, will also be on display at our booth. We are eager to make new acquaintances and to renew friendships.

Chemical and Pharmaceutical Industry Co., Inc.

Booth 32. Electric Universal Thermometer TE-3: galvanometer principle with thermocouple applicators manufactured for every conceivable type of temperature reading. Guaranteed accuracy: 0.1°C. Applicators permanently adjusted at factory. Instrument equipped with automatic compensation for variation in room temperatures. Standard applicators available for skin, muscles, canals, veins, brain, and so on. Special applicators can be furnished according to individual specifications.

"Erweka" All-Purpose Lab-Master: Fourteen available laboratory machines operated by one Universal motor-drive facilitate research and development work. Change-over from one unit to another takes only a few seconds. Easily operated. Three-roller mill, homogenizer, ball mills, vibrator, granulators, coating pans, and other types of laboratory machines are easily operated with this motor-drive.

"Desaga" Laboratory Shaking Machine: Unlike any other available machine of this nature, shaking action is three-dimensional simultaneously on two

planes. Maximum agitation and impact intensity is achieved. Adjustable between 80 and 140 impulses per minute. Suitable for 5-liter bottle or several small ones. Simulates hand action.

CIBA Pharmaceutical Products, Inc.

Booths 84, 85, and 86. Eidophor, a new large-screen television projector, will be featured at the CIBA exhibit, along with a picture story of the development of a pharmaceutical product, "from test tubes to tablets." Eidophor, which was developed in Switzerland, is an integral part of the newly formed closed-circuit color television unit of CIBA Pharmaceutical Products, Inc. This unit is being used for the first time in the scientific sessions of this meeting.

Coca-Cola Company

Booths 27 and 28. Ice-cold Coca-Cola served through the courtesy and cooperation of the Washington Coca-Cola Bottling Works, Inc., Silver Spring, Md., and The Coca-Cola Company.

Columbia University Press

Booth 88. Selective display of books in the field—reference, specialized, and general publications. Agent in the U.S. for publications of the United Nations, UNESCO, and the World Health Organization. See the first volumes of *Peaceful Uses of Atomic Energy* and many other good books in Booth No. 88. Author conferences for proposed publications arranged by Donald Brown, sales manager. *

Consultants Bureau, Inc.

Booth 31. Translations in 19 languages, by bilingual scientists, with emphasis on Russian. Currently translating 29 Soviet research journals (including 15 for learned societies), on a yearly subscription basis; single articles also available. The following are of significant current interest: *Soviet Science and Technology*, a monthly periodical providing, in English, the tables of contents of the latest Soviet scientific journals being translated and published on a continuous basis by Consultants Bureau and other firms; the forthcoming *Russian-English Physics Dictionary* (interim glossaries now available); collections of papers from all our translated Russian journals, 1949-55; *Fused Salts, Glass and Ceramics, Catalysis, Pharmacology, Crystallography*; and a wide variety of other essential scientific publications. In addition, Consultants Bureau has inaugurated a new policy of providing scientists with case-bound translations of important monographs, symposia, and conference proceedings. The first two volumes—*The Structure of Glass* and *The Geology of Uranium*—are now ready, and may be examined at our booth.

Current Contents— Eugene Garfield Associates

Booth 72. Current Contents of Pharmacological Publications will be featured in the exhibit of Eugene Garfield Associates, of 1523 Spring Garden Street, Philadelphia 30, Pa. Consisting of reproductions of contents pages of nearly 400 primary scientific journals, Current Contents covers the broad interests of medical, chemical, and pharmacological research scientists. This service consists, in part, of publication of weekly pocket-size booklets (5½" x 8½") which cover more than 75,000 individual articles per year. Review copies will be distributed gratis. Advance information on new Current Contents services in such fields as electronics, chemistry, and management science will be available.

Denoyer-Geppert Company

Booths 14 and 15. A portion of the Denoyer-Geppert Company display will be devoted to visual-teaching appliances for the biological sciences and related subjects. There will be a generous assortment of Biocraft unbreakable plastic models for human anatomy, botany, zoology, and embryology. An array of beautifully printed, multicolored large wall charts will form the background of the display, covering an even wider range of subject matter. Biocraft osteological preparations will make up a large portion of the display, with emphasis on human skeletons. Among museum mounts and demonstration materials there will be an interesting assortment of Biocraft plastic embedded specimens.

New, leading Denoyer-Geppert wall map publications will be on display, together with globes, particularly the 24-in. physical-political globe of the world, and the new Philip's *University Atlas*. The display will include representative samples of new maps produced in England, Germany, and the U.S.S.R. The display will include geographical, historical, geological, and transportation maps.

Educational Testing Service

Booth 3.

Encyclopaedia Britannica

Booth 26. A brand new edition of the *Encyclopaedia Britannica*, direct from the publisher, will be on display. The special offer, at unusual terms and discounts, available during your meeting, cannot be offered following the close of the convention. This is a "personal" offer and is not designed for institution acceptance.

Folkways Records and Service Corp.

Booth 89. Products of Folkways Records (the world's largest producers of authentic folk music recordings) illustrate in phonorecord form (documented) the sounds, music, and cultures of many

places and peoples of the world. Over 400 peoples have been recorded in the Ethnic Folkways Library, which includes background notes by leading social anthropologists and ethnologists.

In its Science Series, Folkways has released record albums dealing with phenomena such as the Rain Forest, the sounds of the American Southwest, the "talk" of fish, and the happenings during an actual operation. Complete catalog is on display at the Folkways booth, No. 89.

Foringer and Company, Inc.

Booth 11. Automation for behavioral control and monitoring will be the subject of our exhibit; also other biological instrumentation. An unattended automatic program for behavior control will be demonstrated, with a monkey in a primate chair. Part of its behavior will be converted to pulse form for transmission, and a graphic record will be made for immediate or future use. The program has been chosen to suggest practical means of remotely monitoring changes in behavior of an animal in a satellite in space. Other uses of the apparatus will appear, such as its ability to free scientific personnel from long-term routine observation and manual programming for more creative activities. Another apparatus will show means for determining a subject's alertness and ability to discriminate visual and auditory patterns. Most exciting is autoexperimental gear whereby a subject selects his own experimental values, thus offering us means of investigating thresholds of hearing, vision, and pain. The exhibit includes response-contingent programmers, counters, switching devices, timers, cumulative-event recorders, animal cages, and automatic feeders. Representatives will be present to discuss equipment and applications.

General Biological Supply House

Booth 5. Stop in at the sign of the Turtex! Members from the staff of the General Biological Supply House will be on hand to greet our friends and discuss the Turtex products in the cordial atmosphere of our booth. We will be pleased to talk over any special problems or projects that you may have, and to assist you in any ways that we can. Many new items, designed for the teaching of biology in the secondary schools and colleges have been added to our listings, recently. It will be our pleasure to tell you about them. Suggestions for other new biological teaching aids will be most welcome, along with your recommendations on how we can better serve you.

General Electric Research Laboratory

Booths 7 and 8. Among the exhibits will be results of fundamental investigations in the fields of high-temperature gas dynamics, stereospecific polymers, the

microstructure of high polymers, and the mobility and trapping of electrons in liquid hexane. Samples of a new crystal modification of boron will be shown, and there will be a representation of the curing, by irradiation, of high-temperature silicone rubber. Motion pictures will include an explanation of magnetic resonance. A demonstration on the growth of crystal "whiskers" has been designed especially for science teachers.

General Ultrasonics Company

Booth 62. This exhibit will consist of the following items. Variable Frequency Ultrasonic Generator: continuous fine tuning from 10 to 1200 kc; continuous controlled power output to 400 watts; output impedance variable from 3 to 320 ohms; suitable for powering any transducer in these ranges. New Multipower Transducer: reinforced, mechanical-impedance-transformed, electrostrictive; extremely rugged metallic construction; very high efficiency requiring low power; joined to radiating surface by welded studs. Liquid Processing Tank: stainless steel construction; high-efficiency multipower transducers, used for laboratory and small-parts cleaning, degreasing, pickling, plating, extracting, and accelerating chemical reactions.

Also included are Ultrasonic Degasing Equipment: Multipower transducers quickly and efficiently degas liquids. Ultrasonic Soldering Equipment: rapid and effective soldering of aluminum and alloys without fluxing. Ultrasonic Emulsifier: Multipower transducers in a pipeline construction act on nonmiscible liquids to quickly create stable emulsions.

Graf-Apsco Company

Booth 46. The "safest and most fool-proof" microscope for students is exhibited by the Graf-Apsco Company at Booth No. 46. Overcoming the usual "wear and tear" irritations was the primary object in changing the conventional design of microscopes. Every little change was made for a definite reason, to prolong the "like new" life of the microscope. Be sure to see this interesting exhibit where new and guaranteed microscopes are displayed. Bring your repair and maintenance problems to Graf-Apsco, America's leading microscope repair house.

Harvard Apparatus Company, Inc.

Booth 2. The Harvard Apparatus Company, Inc., a nonprofit organization, will exhibit its complete selection of apparatus useful in teaching and research in physiology and allied sciences. Included will be kymographs and accessories, infusion pumps, respiration pump, levers, and clamps. New apparatus shown will include ink writing attachments, an electronic stimulator, and a continuous self-filling infusion pump.

D. C. Heath and Company

Booth 39. From kindergarten to graduate school, educational philosophy, teaching procedures, and teaching materials are today being scrutinized as never before. Heath is exhibiting mathematics and science texts—at elementary, secondary, and college levels—that stand up under this scrutiny. No matter what your specialty, we think it will pay you to spend some time with us. Examine the modern mathematics and science texts at all levels. In particular, we think you will be interested in: *Heath Elementary Science* (1959); *Learning to Use Arithmetic* (1958), an elementary school series; *Biology*, by Kroeber, Wolff, and Weaver, a high-school text; *First Year Algebra* (1957) and *Second Year Algebra* (1957), by Hart, Schult, and Swain; *Plant Classification* (1958), by Lyman Benson; *Introduction to Organic Chemistry* (1957) and *Basic Organic Chemistry* (1959), by Fieser and Fieser; and *Analytic Geometry and Calculus* (1957), by William L. Hart.

Henry Holt and Company, Inc.

Booth 66. The Henry Holt and Company exhibit displays this year an outstanding list of textbooks, including the former Dryden Press titles. Of special interest are the many new and timely publications representing a diversity of science subjects. Among the titles on display are: Andree, *Selections from Modern Abstract Algebra*; Barth, *Embryology*, revised; Bickle-Houp, *Reports for Science and Industry*; Gaskell, *Engineering Mathematics*; Gould, *Inorganic Reactions and Structure*; Hogness-Johnson, *Introduction to Qualitative Analysis and Qualitative Analysis and Chemical Equilibrium*, fourth edition; Pare, *Engineering Drawing*; and Wilson-Loomis: *Botany*, revised.

Johns Hopkins University

Booths 55 and 56. The Johns Hopkins University has prepared an informative display on new frontiers of knowledge. Space for the exhibit has been provided through the courtesy of the Baltimore Gas and Electric Company. This exhibit reflects the variety of significant activities carried out at the university through the Faculty of Philosophy, the School of Engineering, the School of Medicine, the School of Hygiene and Public Health, and the School of Advanced International Studies, and with such special facilities as the Operations Research Office and the Applied Physics Laboratory.

Labline, Inc.

Booth 98. Labline, Inc., will show many new laboratory items, all of them in operation. Among the items shown will be the new 1959 models of various types of Imperial centrifuges (table and floor models); Imperial incubators;

water baths; hot wall heated electric sterilizers; slide warmers; Alumaloy clamps; chromatofuges and other types of electrophoresis apparatus; low temperature storage cabinets for tissues, vaccines, and so on; ultrasonic cleaning machines; universal shaking machine for all sizes of laboratory glassware; and many other items for the laboratory. In attendance will be Alexander I. Newman, president, Donald V. Magnuson, director of research, and Jordan D. Abel and Frank R. Wilson, representatives.

LaMotte Chemical Products Company

Booth 36. LaMotte Chemical will exhibit representative examples of the products that have contributed to the world-wide reputation of this firm, now in its fortieth year of service to Science, Industry, and Agriculture. On display will be a small portable outfit for the field inspection of foodstuffs; the new Suessenguth-Kline Slide Test for the clinical diagnosis of Trichinosis; organic reagents for the colorimetric analysis of trace elements; synthetic phospholipids, commercially available for the first time; soil testing outfits and equipment; micro clinical test sets; and pH indicators, color standards, buffer solutions and comparators.

E. Leitz, Inc.

Booth 79. E. Leitz, Inc., plans to exhibit for the first time a Double-Beam Interference Microscope. Also on show will be their new Micro Manipulator; Base Sledge Microtome for sections under one micron as well as their standard Freezing Microtome; Universal Microscope with Plano flat-field objectives, Phase contrast optical system after Heine and incident light equipment, also color phase equipment; 500 watt and carbon arc microprojectors; the Universal Camera Microscope Panphot with new high intensity Xenon lamp; various medical laboratory type microscopes with new design features and Binocular Prism high and low power Magnifiers. The latest fluorescence light source for research microscope Ortholux UAM will be demonstrated.

Linguaphone Institute

Booth 22. The Linguaphone Method for language learning—in spare time—at home—has wide acceptance among scientists in every discipline. The Linguaphone display features home-study courses in the 34 most important languages of Europe, Africa and Asia. Spanish, Russian, German and French are in particular demand.

The Relaxed Way to Learning is also a feature of the display. Here are demonstrated two electro-mechanical devices designed not only to speed up the assimilation and retention of knowledge, but

also to utilize profitably some of the time which often disappears in the "no-man's land" of sleep. The devices are: The tape-recording Dormiphone Memory-Trainer and the Dormiphone Record Player. Both units are designed to enable the learner to reinforce his wakeful study by "sleep learning"—listening to material automatically iterated during sleep.

Martin Company

Booths 80 and 81.

McGraw-Hill Book Company, Inc.

Booth 73. McGraw-Hill Book Company welcomes you to the meeting. You are cordially invited to browse through our exhibit here at Booth No. 73 (on your left as you enter). You will find on display McGraw-Hill publications in all areas of science. Our biological science books include, among others, Storer and Usinger's third edition of *General Zoology*, Sinnott, Dunn, and Dobzhansky's fifth edition of *Principles of Genetics*, the second edition of Langley & Cheraskin's *Physiology of Man*, Patten's *Foundations of Embryology*, and Pelczar and Reid's *Microbiology*. Among the physics and engineering books you will see Krauskopf's *Fundamentals of Physical Science* (a new edition is presently in press), Smith and Cooper's sixth edition of *Elements of Physics*, Weber, White, and Manning's *Physics for Science and Engineering*, Zemansky's fourth edition of *Heat and Thermodynamics*, Adams' *Space Flight*, Carter's *Realities of Space Travel*, and Present's *Theory of Gases*. The area of geography is represented by Freeman and Morris' *World Geography* as well as by many other texts. Some of the outstanding books in the field of geology include *Introduction to Historical Geology*, by R. C. Moore, and *The Earth and Its Gravity Field*, by Heiskanen and Vening Meinesz. From the Blakiston Division you will see such titles as *Dynamic Anatomy and Physiology*, by Langley, Cheraskin, and Sleeper, and *Electron Microscopic Atlas of Normal and Leukemic Human Blood*, by Low and Freeman and a number of others.

Medical Dental Scientific Photographic Equipment Co.

Booth 76. Inexpensive photographic equipment for close-up pictures, using electronic flash with either the Circle Flash (for shadowless pictures) or the Side Light (for pictures with shadows). Featured will be our simplified set-ups using our moderately priced cameras, or we can adapt other cameras to the set-ups.

For the novice photographer or the science instructors, we would particularly like to suggest that they investigate the new Kodak Starflash Outfit. This extremely easy to use close-up set-up is

being solely presented by our company, and we believe that it will have many diversified uses in the science field. Since this is our first exhibit at an AAAS meeting, we would welcome the opportunity to discuss any photographic problems of those attending the meeting.

G. & C. Merriam Company

Booth 42. The Merriam exhibit will consist of a panel of photographs showing various processes in the making of our dictionaries. There will be a display of copies of all Merriam-Webster publications together with instructional aids illustrating how they can be used most advantageously.

Mettler Instrument Corporation

Booth 87. Mettler Instrument Corporation will exhibit representative instruments from its line of analytical, precision, and multipurpose balances. To be featured in the exhibit will be models of its new multipurpose line. These balances feature a capacity of 160 g with accuracies to 0.01 mg. Also to be shown will be the high-speed direct-reading precision balances with capacities to 4 kg, as well as models of the well-known analytical series.

Microbiological Associates, Inc.

Booth 6. Microbiological Associates, Inc., Bethesda, Maryland, will present: (i) Viable tissue cultures of 30 different mammalian cell strains; (ii) certain methods of standardization used for pre-testing media and reagents; (iii) diagnostic viral reagents such as new typing antisera for Coxsackie and ECHO viruses; hemadsorption, influenza, measles, and adenovirus complement-fixation antigens (virologists will be in attendance); (iv) availability data on MA strains of mice—Inbred: C57/B1₆, dba/2, Balb/c and C₅H; Hybrid: BDF₁, DBF₁, and cbda; also heterozygous animals in random bred Swiss mice, Wistar rats, and hamsters.

Microcard Foundation

Booth 41. The Microcard Foundation, an affiliate of the University of Wisconsin Press, is jointly exhibiting with the Microcard Corporation. The Foundation publishes various titles in the sciences and humanities on Microcards (3- by 5-in. cards containing approximately 50 microimages per card).

A representative will be available to discuss titles for publication in this medium. Also, of interest to those concerned with data dissemination problems, is the story of the world-wide dissemination of IGY meteorological data on Microcards.

Wildlife Disease, a publication of the Wildlife Disease Association and the American Institute of Biological Sciences, through the aid of a grant from

the Council on Library Resources, starts publication of a unique new journal on 1 Jan. 1959. The journal—*Wildlife Disease*—consists of printed abstracts and Microcarded articles. This new journal will also be shown.

Muscular Dystrophy Associations of America, Inc.

Booth 99. The MDAA, Inc., exhibit presents information concerning the manifestations of muscular dystrophy and is composed of three distinctive panels, presenting the following: (i) color transparencies with appropriate descriptions of the manifestations of dystrophy—the genetics of the condition is graphically shown and discussed; (ii) the second panel presents postural changes and characteristics of the early and advanced stages of progressive muscular dystrophy; (iii) the third panel presents color transparencies of personnel engaged in the various MDAA-sponsored research projects under the grants-in-aid program. The dystrophic mouse, now extensively used for this research, is shown and described. The hereditary aspects of the condition are explained. The Institute for Muscle Disease, an MDAA-sponsored project which will open early in 1959, is pictorially and functionally described. An automatic playback tape features an informational interview, on the subject of progressive muscular dystrophy, with Dr. Melville H. Manson, scientific director, MDAA, Inc.

National Biological Laboratories, Inc.

Booth 54. The National Biological Laboratories, Inc., nationwide distributors of biological preparations, specimens, and models and equipment, and primary supplier of these items to the institutions in the metropolitan area of the nation's capital, takes great pride in exhibiting a variety of its products to the 125th Meeting of the American Association for the Advancement of Science. The interest of all visitors to our exhibit booth will be keenly stimulated by the impressive variety of this display, which is indicative of the virility and rapid expansion of our relatively young establishment. Among the osteological preparations in the exhibit will be a natural human skeleton with muscle insertion and origins painted and lettered in, and ligamentary cat skeletons mounted on new, lightweight bases with their feet embedded in clear plastic. There will be a number of preserved animal specimens displayed in glass jars, and one of our fine embalmed and doubly injected turtles with the plastron removed for examination of the circulatory system.

Our excellent anatomical models, made of a hard, unbreakable, washable plastic will be represented in part by a

fine human torso with eight removable parts, an enlarged model of the inner and middle ear, and an enlarged model of the human heart. In the equipment line we will have for your inspection two brands of nationally acclaimed microscopes and a well-known microprojector, in addition to several other items necessary in every biology laboratory. Please feel free to examine everything in the exhibit, and be assured that our salesmen are eager to demonstrate for you, and consult with you, on any special problems or requirements you may have.

National Geographic Society

Booths 64 and 65. The exhibit of the National Geographic Society will feature the *National Geographic Magazine* and the *Geographic School Bulletins*. Also on display will be maps, books, pictures, and other special educational materials of the Society. An automatic projector will screen a continuous selection of natural color slides. The slides cover National Geographic field assignments and expeditions and were selected from illustrations by staff photographers of the *National Geographic Magazine*.

National Institutes of Health

Booth 52. The National Institutes of Health are the principal research arm of the Public Health Service, U.S. Department of Health, Education, and Welfare. The Institutes are devoted to the conduct and support of medical research, and the exhibit depicts in summary, graphic form the NIH programs, one panel concerning the research conducted by the Institutes and the other, NIH support of research, training, and the construction of research facilities.

Seven Institutes form the family of NIH: Allergy and Infectious Diseases, Arthritis and Metabolic Diseases, Cancer, Dental Research, Heart, Mental Health, and Neurological Diseases and Blindness. Serving NIH as a whole are the Clinical Center (a 500-bed, 1000-laboratory research facility) and three Divisions—Research Grants, Research Services, and Business Operations. Two other Divisions—Biologics Standards and General Medical Sciences—conduct programs, the first regulatory in the field of biologics and with its own research, and the second, General Medical Sciences, serving as the focus for research and training grants in general rather than categorical fields of medicine and allied sciences. Free literature describing NIH programs is available at the booth.

National Instrument Laboratories, Inc.

Booth 82. This exhibit will feature a complete line of microscopes from Christian Beck and Sons and a chromatograph for scanning and integrating paper electrophoresis strips, as well as a field emis-

sion electron microscope used for studying crystal structure, and so on. Also shown will be a surface tensiometer used for determining surface tension of liquid, using a one-drop sample at controlled temperatures, and a flame photometer.

National Science Foundation

Booth 21. The National Science Foundation, an independent federal agency, is responsible for promoting scientific progress through: (i) developing and encouraging the pursuit of a national policy for promoting basic research and education in the sciences; (ii) initiating and supporting basic scientific research and appraising the impact of research upon industrial development and upon the general welfare; (iii) awarding scholarships and graduate fellowships in the sciences; (iv) fostering interchange of scientific information among American and foreign scientists; (v) evaluating scientific research programs undertaken by federal agencies, and correlating the Foundation's scientific research programs with those undertaken by individuals and by public and private research groups; (vi) maintaining a register of scientific and technical personnel and providing a clearinghouse for information covering such personnel in the United States; (vii) initiating and supporting, at the request of the Secretary of Defense, specific scientific research activities connected with national defense matters.

The NSF exhibit illustrates operating Foundation programs for carrying out these responsibilities.

New American Library

Booth 9. Works in every field of science, from anthropology and atomic physics to zoology, by outstanding authors such as George Gamow, Fred Hoyle, James B. Conant, Julian Huxley, Margaret Mead, and Rachel Carson, are to be found in the attractive inexpensive Mentor and Signet Key paperbound books. Included are 49 titles in the 1958 AAAS list, "An Inexpensive Science Library," selected by Dr. Hilary J. Deason, Director of the High School Science Library Program.

Mentor and Signet Key books arouse the interest of young people and start them toward scientific careers and help others understand science and its crucial importance in the world today. These books are acclaimed for their excellence and low price. Examination copies will be available on request of teachers who wish to consider them for class use.

Nuclear Products—Ercō

Booth 10. The Nuclear Products—Ercō Division exhibit consists of five panels illustrating the diversified activities of this division. Panels showing the MIT

Heavy Water Research Reactor and the U.S. Air Force Radiation Effects Reactor illustrate this division's contribution to the technology of reactor engineering.

The MIT Reactor is a heavy water cooled and moderated type reactor and will be operated at 1000 kw, producing a flux of $10^{18} \text{n/cm}^2/\text{sec}$; it is the first of its type ever to be built for private use. Facilities include experimental ports and thimbles, medical therapy arrangement, gamma irradiation room, chemistry hot labs, reactor control room, and equipment for servicing reactor building.

The Air Force Reactor was designed specifically for radiation effects studies and will operate at a power level of 10,000 kw. Test cells adjacent to the reactor are equipped with facilities to determine behavior of nuclear aircraft equipment under irradiation and simulated high-altitude flight conditions. These cells are loaded and unloaded by a remotely controlled rail car system. Facilities include fuel element storage and gamma irradiation well, bulk shielding facility, thermal column and beam tubes, and radiation space within the reactor vessel. A model of the 604 Pool Training Reactor, designed primarily for educational purposes, will also be displayed.

Other panels will show the F-105D Flight Simulator (Air Force) and the S2F-3 Weapon System Trainer (Navy) and illustrate the latest Erco contributions to the vital training programs presently conducted by the Armed Forces. The F-105D Flight Simulator permits the training of pilots in the handling of the latest all-weather interceptor ordered by the Air Force. It offers facilities for the simulation of typical mission profiles from take-off to landing, and incorporates some novel and proprietary methods of ground mapping radar simulation. The S2F-3 Weapon System Trainer offers complete facilities for the integrated training of flight crews in the latest techniques of antisubmarine warfare. It covers all stages of "hunter-killer" operations, from search to track, and synthesizes the most up-to-date electronic and ordnance systems to be employed by Navy aircraft for this critical phase of our National defense.

The panel showing the Atlas missile in flight is symbolic of the contribution that Erco is making in the field of maintenance crew training. Under subcontract from the General Electric Company, a complete system of trainers is being designed and manufactured for the ground-base control and guidance equipment for the Atlas missile.

Oak Ridge Institute of Nuclear Studies

Booth 25. The Oak Ridge Institute of Nuclear Studies is a nonprofit educational corporation of 37 southern uni-

versities, operated under direct contract with the U.S. Atomic Energy Commission. Its primary aim is the integration of the extensive facilities of Oak Ridge in the pattern of scientific education in the South. The Institute administers several A.E.C. special fellowships; a research participation program through which university faculty members carry out research at Oak Ridge; a graduate program for doctoral candidates who use the specialized Oak Ridge facilities for thesis research; a traveling lecture program which sends Oak Ridge scientists to speak on university campuses; a nationwide traveling science teacher program for secondary schools, supported jointly by the National Science Foundation and the U.S. Atomic Energy Commission, which was expanded this year to include cooperatively developed and supported state programs; and other educational programs. The Institute also operates a medical-research hospital; a radioisotope techniques training program; an atomic-energy museum; and traveling atomic-energy exhibits.

Office of Naval Research

Booth 45. The Office of Naval Research will have an exhibit on research in the preservation and transplantation of tissues such as skin, bone, at the annual meeting of the American Association for the Advancement of Science. It will show the type of research being carried on in this and related areas, which are a part of ONR's program for basic and developmental research in the biological sciences. Highlighted in this exhibit, for example, are basic and developmental research in the exploration of the use of tissue substitutes such as bovine embryo skin, anorganic bone, plastic blood vessels, and the plastic cornea. Results of defects and their repair are illustrated in color.

Phipps and Bird, Inc.

Booth 58. We will display apparatus of interest to both the teacher and investigator in physiology, psychology, and related fields, with emphasis on class room equipment such as kymographs, tambours, and stimulators.

Potomac Electric Power Company

Booths 74 and 75. The Potomac Electric Power Company of Washington, D.C., a member of Atomic Power Development Associates, Inc., and Power Reactor Development Company, will present an exhibit relative to the Enrico Fermi Atomic Power Plant. This plant, which is now under construction on the shores of Lake Erie, approximately 30 miles southwest of Detroit, Michigan, will have the world's largest "breeder" power reactor. The importance of the breeder reactor in relation to the economic and commercial aspects of reactor

development lies in its unique ability to produce more nuclear fuel than is consumed in the process of generating heat for the production of electric power. The initial steam output of the Fermi Plant, scheduled for completion in 1960, will permit the generation of 100,000 kilowatts of electric power.

The reactor has been designed by Atomic Power Development Associates, Inc., a nonprofit organization composed of 43 member companies, which is devoting its entire efforts to finding better routes to commercial atomic power through extensive research, development, and testing programs. There will be on display in the exhibit a model of the Enrico Fermi Atomic Power Plant along with a model of the breeder reactor and some of its component parts.

Power Reactor Development Company, a nonprofit membership corporation made up of 26 utility and manufacturing companies, is currently financing and constructing the breeder power reactor which it will own and operate. At the same time that the reactor plant is being constructed, the Detroit Edison Company is erecting a conventional steam turbine generator plant to be used in conjunction with the reactor.

The Enrico Fermi Atomic Power Plant is an outstanding example of a dedicated industry's determination to make the atom a powerful peacetime force for the advancement of civilization. The breeder type reactor being used in this project will add to the nation's reserves of nuclear fuels rather than deplete those resources.

The Rayoscope Company

Entrance. At the Rayoscope booth images of microscopic specimens will be projected on a screen at a distance so that a large number of people can observe simultaneously. Special emphasis will be placed on projection of living specimens and on the minute detail of projected image. Our specially designed lenses and pure white light source make it possible to show intricate detail of both living and stained specimens. You no longer have to be satisfied with generalities. A revolutionary new type of projection screen will be demonstrated. This screen permits projection in a well-lighted room—even in a room such as a television studio with numerous flood lights burning. For the best and finest in micro-projection come to the Rayoscope booth.

Rinehart and Company, Inc.

Booth 51. The exhibit of the College Department of Rinehart and Company, Inc., New York City, will display Rinehart publications in the areas of science and science education. The Rinehart representative at the exhibit will be Alfred S. Schenckman, who holds the degree

of Master of Science from the University of Minnesota and the University of Chicago.

The publications displayed will cover the areas of anthropology, biology, chemistry, statistics for behavioral scientists, mathematics, physics and include a wide selection of books which are used for training future teachers of science.

Row, Peterson and Company

Booth 95. The newly established College Department of Row, Peterson and Company is entering the college field with the publication of a number of outstanding textbooks and monographs. Among its initial company of authors are Abram Bergson, Hans Bethe, Frederic de Hoffmann, Don Patinkin, and Robert R. Sears. Among its fields are biology, chemistry, economics, physics, psychology, and sociology.

The department comprises three important elements: (i) an editorial staff experienced in college and university work, (ii) the company's 51 years of experience in designing and manufacturing quality books, and (iii) a sales force covering virtually every college and university in the United States. We invite you to stop and examine some of the books we have already published.

Schwartz Laboratories, Inc.

Booth 30. Schwartz Laboratories is the world's oldest and largest producer of nucleic acid compounds and yeast derivatives. Members of the Schwartz staff will be present to answer questions about the 200 products of biochemical and medical importance now being made by the company. Among the latest Schwartz Preparations included in the exhibit are tritiated thymidine, tritiated cytidine, tritiated adenosine, tritiated 2-deoxy-D-ribose, C^{14} -L-glutamine, N^{15} -L-amino acids, 8-L-glutamyl hydrazide, L-pyrrolidine carboxylic acid, sodium adenosine 5'-phosphoramidate, crystalline disodium uridine 5'-monophosphate, 2-aminoethyl-iodothiouronium bromide hydrobromide, and flavin adenine dinucleotide. Other key tools for biomedical research featured in the Schwartz exhibit include nucleic acid compounds; purines and pyrimidines; adenosine phosphates; glutathione and other sulfhydryl compounds and reagents; deoxyribonucleosides; optically standardized amino acids and kits; C^{14} , S^{35} , and P^{32} radiochemicals; and clinical preparations. The products pioneered by Schwartz Laboratories are aiding scientific studies by providing some of the research tools used in the whole area of biomedical research, from investigations of fundamental metabolic, enzymic, physiological, and genetic aspects through nucleotide and peptide synthesis, and in clinical investigations of nutrition, neoplasm, and cardiac and vascular ailments.

Science Library

Booths 91, 92, 93. The Science Library is administered by the AAAS as an additional service to publishers of books, both exhibitors and nonexhibitors. It has become an integral part of each year's Annual Exposition of Science and Industry. In the Science Library, books of all publishers participating are grouped by fields of science—a convenience both to the visitor who is restricting his inspection of books to a single category and to the one who wishes to browse. Among the publishers in the Science Library are: American Association for the Advancement of Science; Academic Press, Inc.; Addison-Wesley Publishing Company, Inc.; Annual Reviews, Inc.; Association Press; Cambridge University Press; Catholic University of America Press; E. P. Dutton and Company, Inc.; Emerson Books, Inc.; W. H. Freeman and Company; Grove Press; Harcourt Brace and Company; Houghton Mifflin Company; Johns Hopkins University Press; Macmillan Company; Josiah Macy, Jr. Foundation; C. V. Mosby Company; New American Library; Oxford University Press; Prentice-Hall, Inc.; Reinhold Publishing Corporation; Row, Peterson and Company; St. Martin's Press Inc.; Charles Scribner's Sons; University of North Carolina Press; D. Van Nostrand Company, Inc.

Joseph E. Seagram and Sons, Inc.

Booths 100 and 101. Congeners (fusel oil, aldehydes, acids, etc.) are compounds found in all alcoholic beverages that provide the taste, bouquet, and color. In high concentrations, however, certain congeners may produce toxic effects. This exhibit presents the results of quantitative chemical analyses of congeners found in six leading types of distilled spirits, along with correlated acute oral toxicity studies obtained on rats. Pertinent literature will be available.

Science Materials Center

Booth 38.

Special Libraries Association, Washington Chapter

Booth 94.

Ivan Sorvall, Inc.

Booth 57. On display will be a number of completely new Servall Centrifuge developments, some of which are right in line with the modern trend toward automation. Shown in operation will be the Szent-Györgyi & Blum 8-Tube Continuous Flow System, the Type SS-3 Pushbutton Automatic and the type SS-4 Enclosed Superspeed Centrifuges, a new Large-Capacity High-Speed Rotor, the Sharp Particle (Virus) Counting Rotor, and a Field Aligning Swinging Bucket Rotor. Also on display will be the well-known Servall table model centrifuges, the Servall Omni-Mixer with micro-

attachment, the Servall Porter-Blum Microtome. Several new LKB chromatography and electrophoresis instruments will also be shown.

Spinco Division, Beckman Instruments, Inc.

Booth 37. Beckman/Spinco will show the production model of its new Amino Acid Analyzer, which rapidly and automatically quantitates the amino acids found in protein hydrolysates and physiological fluids and the Model K High Force Centrifuge with its new continuous-flow rotor.

Features of the Spinco continuous-flow rotor include freedom from foaming, frothing, and aerosol effect. Flow rates of 500 ml per minute are possible, depending upon the sedimentation rate of the material being processed. The rotor develops forces 28,000 times gravity at 18,750 rpm, and features a "vertical wall" design for increased sedimenting efficiency.

Thiokol Chemical Corporation

Booths 69, 70, and 71.

John I. Thompson and Company

Booth 43. This exhibit displays information as to the services furnished by John I. Thompson and Company, an engineering organization with main offices in Washington and laboratory facilities at Bellefonte, Pa. The company provides research, development, and design services, with supporting activities in technical writing and graphics. A brochure defining the scope and special fields of effort is available at the booth. A leaflet *Planning Your Report*, is of particular interest to research and development scientists, engineers, and all AAAS convention visitors. This is a handy guide packed with report-preparation instructions and with references to items of organization, format, data presentation, illustration, and reproduction—details generally overlooked by the research writer but which are vital to communicating the results of his research. Free with the "Compliments of JITCO".

Principal engineers and illustrators of JITCO will be in attendance to answer queries concerning the many services offered and particularly the creative and design services for the exhibits, presentations, and visuals so essential today in communicating the arrangements of complex devices or data.

A feature of the exhibit is a series of transparencies designed and produced by JITCO to illustrate a Department of Commerce presentation of the Nuclear Ship "Savannah." Conception of such material is commonly a JITCO production incident to preparation of engineering data and writing about new things in industry.

Tobacco Industry Research Committee

Booth 53. Information about the nature and extent of the scientific research program developed and directed by the Scientific Advisory Board to the Tobacco Industry Research Committee. The research program, covering all phases of tobacco use and health, contains three main areas of investigation within which are the specific fields of research. These areas and specific fields are described.

United Fruit Company

Booths 77 and 78. United Fruit Company's exhibit, "Problems and Progress in the Big Three," illustrates the major research program being directed against the three most serious plant diseases which limit banana production in tropical America. The research problem is defined by color transparencies of disease effects on the fruit and plant, by black-and-white photographs depicting experimental control procedures and the scientific effort involved, and by stylized models showing method of infection by the organisms. Tape recordings heard through a battery of French telephones briefly discuss further aspects of the scientific challenge. Side panels describe scientific research careers in the tropics and show the areas of company operations in Central America and the Caribbean.

U.S. Department of Health, Education, and Welfare, Division of Radiological Health

Booths 18 and 19. This exhibit names sources of radiation, effects on human life, and what must be done to curtail excessive radiation. It details the program of the Public Health Service in measurement and analysis of radiation, research,

and training of personnel in detection and control of radiation, and gives specific examples of aid rendered to states in radiation control of detection.

Universal Scientific Company

Booth 90. Universal Scientific Company, Inc., Vincennes, Ind., manufacturers of science electrical and electronics educational equipment. The equipment is complete with texts and lessons. The equipment enables the instructor to convey the subject visually to the class in a very short period of time. Student equipment makes it possible for the student to discover the principle for himself.

Washington Gas Light Company

Booth 68. The method and economic advisability of storing natural gas underground in natural formations is described in the exhibit of Washington Gas Light Company. This company, which distributes natural gas to the greater Washington, D.C., area, is currently in the process of establishing such underground storage facilities in Prince George's County, Maryland. The central panel of the exhibit depicts a typical cross section of sediments, or water-bearing stratum, suitable for gas storage. It is animated to show graphically the injection and withdrawal of gas from the underground anticline, or storage dome. Adjoining panels illustrate the economic advantage of gas storage.

W. M. Welch Manufacturing Company

Booths 33 and 34. The W. M. Welch Manufacturing Company plans to display selected apparatus used in the physics, chemistry, and biology laboratories. These will include those especially adapted to the teaching of science in the

secondary schools and colleges, as well as some items specifically designed for special use in research and industrial laboratories. A partial list includes, stainless steel balances, quick operating high vacuum pumps, electrical measuring instruments, electronics teaching devices, Densichron for measuring optical density, color saturation, and paper chromatograms. Many charts and other visual aids for teaching science, mathematics, and physiology, together with preserved specimens, synthetic skeletons, and other biological models, will be shown.

Westinghouse Electric Corporation

Booths 23 and 24. The Electronics Division display consists of a series of action diaramas depicting divisional fields of interest. Nine distinct scenes rotate fully in 90 seconds. Tieing in with the diaramas is a tape which tells the story behind the exhibit.

Some of the subject matter covered in the various diaramas are: (i) ground to air, ground to ground, and ground to ship communications; (ii) shipboard and submarine communications; (iii) missile ground control; (iv) shipboard radar; (v) tactical and air defense radar; (vi) anti-jamming techniques; and (vii) research.

Each of the diaramas is a replica of Electronics Division equipment applications actually in use or to be used by the military services.

John Wiley and Sons, Inc.

Booth 20. On display at the booth of John Wiley and Sons, Inc., will be text, reference, and professional books in all the principal fields of science and engineering technology; the level of these books is college and above.

nication and coordination with industry, universities, and government organizations are required in order to maintain aggressive, progressive research programs. A committee will promote communication with other workers in the same or allied fields by reviewing research in progress, considering new problems, and making recommendations regarding the direction in which future research should go.

The committees will be concerned with the following fields: fluid mechanics; aircraft aerodynamics; missile and space craft aerodynamics; control, guidance, and navigation; chemical energy processes; nuclear energy processes; mechanical power plant systems; electrical power plant systems; structural loads; structural design; structural dynamics; materials; and aircraft operating problems.

All members of the committee will be

News of Science

NASA Research Advisory Committees

Thirteen new Research Advisory Committees are being formed to provide technical counsel to the National Aeronautics and Space Administration. T. Keith Glennan, NASA administrator, reports that he expects to have the committees functioning early next year.

Glennan has also announced formation of a new Special Committee on Life

Sciences to advise the NASA on matters connected with human factors, medical and allied problems of NASA's manned space vehicle program. Chairman of the Special Committee is W. Randolph Lovelace II, director of the Lovelace Foundation for Medical Education and Research, Albuquerque, N.M. Lovelace is a specialist in aeronautical and space medicine.

When he announced the advisory committees, Glennan explained that commu-

appointed in their professional capacities as individuals by the NASA administrator and the committees will report to him. As far as feasible, committee membership will be kept small to facilitate discussion and decision.

The new research committees will supersede the 28 technical committees and subcommittees of the National Advisory Committee for Aeronautics, which was absorbed by the NASA when it was established last October. The NACA committees and subcommittees are due to go out of existence on 31 December.

Research Corporation Grants

The Research Corporation distributed \$259,259 as grants-in-aid during the last quarter of fiscal 1958, which ended 31 October, bringing the annual disbursement to \$1,244,000. The foundation distributed \$1,257,000 in grants-in-aid in fiscal 1957.

The last quarter grants were made among four areas of the foundation's interests. These areas, and the amounts granted, are as follows:

Frederick Gardner Cottrell Grants—\$146,900 granted to 46 colleges and universities in 24 states, and abroad to the American University of Beirut for basic research in the natural sciences;

The Williams-Waterman Fund for the Combat of Dietary Diseases—68,260 granted to universities both in the United States and abroad for basic research and experimental programs related to the field of human nutrition;

The Brown-Hazen Fund—\$4,700 granted to Baylor University for support of fundamental research in biochemistry, microbiology, and immunology;

Howard Andrews Poillon Fund—\$39,391 granted to four universities in the United States for programs of "exceptional scientific merit" which fall outside the scope of the major funds.

Research Corporation is a nonprofit foundation established in 1912 by the late Frederick Gardner Cottrell, who was a professor of chemistry at the University of California. The foundation supports research in the natural sciences in educational and scientific institutions.

Teacher Recruitment in New York

Some 526 leading scientists, including 15 Nobel prize winners, have announced their support of a far-reaching proposal by a committee of science educators to spur recruitment of teachers and improve science instruction in the New York City public high schools. The proposed plan calls for a sharp increase in expenditure on the high schools. It asks the Board of Education to initiate public relations efforts, legislative activity, and

independent budgeting in order to mobilize public support for the increase. It details requirements in the high schools on which money must be spent to make science teaching more effective.

The plan was framed by the Joint Committee on Science Teacher Recruitment, representing science department chairmen of the New York City high schools. Stanley L. Weinberg is chairman of the committee, which has an office in the headquarters of the New York Academy of Sciences, 2 E. 63 St.

Harold C. Urey, Nobel Prize winner and distinguished service professor of chemistry at the University of Chicago, says of the proposal:

"I think this is an excellent statement. The budget of the schools of the United States should be doubled. I have just visited Israel, a country of two million, in very difficult circumstances, and yet able to afford three institutions of higher learning. Saudi Arabia, with hundreds of millions of oil royalties, cannot afford primary-school education. A people can afford what they wish to afford, and it is necessary to get the people of the United States to understand that we must afford better education. The city of New York should lead in this."

The American Scientist's Knowledge of Foreign Languages

More than 97,000 scientists in the National Register of Scientific and Technical Personnel in 1954-55 reported a knowledge, with varying degrees of proficiency, of at least one foreign language. This constituted approximately three-quarters of the 127,000 persons in the Register, and it is estimated that more than one-half of all American scientists were included in the Register during this period.

German was the language reported most often, and French next, obviously a reflection of educational requirements for scientific training, particularly at the graduate level. By scientific field, those in chemistry and chemical engineering and in physics and astronomy showed a greater concentration in the Germanic languages, while in psychology and the earth sciences there were proportionately greater numbers with knowledge of French, Spanish, and other Romance languages.

Only about 1 in 50 of those reporting a language ability had a knowledge of Russian and less than 1 in 100, of Chinese. In the case of these languages, it appears that such knowledge stems largely from nativity and family background. These findings indicate that nearly all American scientists must depend on translations for knowledge of scientific developments in the Soviet bloc countries.

Blood of Aquatic Animals

The first symposium on the blood of aquatic animals was held in Tokyo, Japan, on 3 November under the sponsorship of the Japanese Fisheries Agency and the Japanese Fisheries Society. The purpose of this symposium was to establish an organization for the discussion of problems relating to the blood of aquatic animals. Abstracts of the seven papers presented will be published in English in the *Japanese Journal of Ichthyology*, volume 7, Nos. 2, 3, 4 (now in press). These papers were concerned with antigens in the blood of oysters, mackerel, tuna, and whales, the blood composition of carp, and the physiology of blood in relation to the productivity of fish ponds. Correspondence concerning this symposium and succeeding ones should be sent to Professor Y. Suyehiro, Chief, Department of Fisheries, Division of Agriculture, Tokyo University, Bunkyo, Tokyo, Japan.

Argentine Astronomy

On 7-9 November, a meeting was held by Argentine astronomers at the Felix Aguilar Observatory of the University of Cuyo in San Juan. Seventeen papers, three general reports and ten progress reports, were presented. An important outcome of the meeting was the founding of the Argentine Astronomical Association and the election of the members of the Argentine National Committee for Astronomy. The officers of the new association are B. H. Dawson, president, J. J. Nissen, vice-president, C. Jaschek, secretary, J. Landi-Dessy, treasurer, and C. U. Cesco and J. L. Sersic, councilors. L. Gratton, C. Jaschek, R. Platzeck, and J. Sahade are the members of the National Committee.

Foreign Medical Graduates' Examination Results

Results of the first world-wide American Medical Qualification Examination held 23 September in 30 U.S. examination centers and 30 foreign centers have been announced by Dean F. Smiley, executive director, Educational Council for Foreign Medical Graduates. The foreign centers were established in Latin America, the Far East, the Middle East, and Europe.

Statistics reveal that of the 844 foreign-trained physicians taking the examination, 418 passed and will receive the ECFMG Certificate. According to the council, these physicians are certified as possessing medical knowledge reasonably equivalent to that expected of graduates of approved American and Canadian medical schools and as having

satisfactory facility in the English language.

The examination results also indicate that 226 candidates came sufficiently close to passing, in spite of language difficulties, to earn temporary certificates which will qualify them to study not more than 2 years as interns or residents in U.S. hospitals approved for internship or residency training.

Those foreign-trained physicians who pass the examination and enter the U.S. on exchange visitor visas may participate in the National Intern Matching Program or apply directly to a hospital for an internship or residency. In addition, graduates entering the U.S. on immigrant visas may be admitted to licensing examinations in at least 16 states.

Located in Evanston, Ill., the Council for Foreign Medical Graduates was established in 1957 as a means of evaluating the education of foreign medical graduates wishing to take advanced training or obtain licenses in the United States. On 25 March of this year the council administered the first examination of this type in 17 stations in the United States. Fifty-one percent of the 300 applicants tested passed this initial test.

The American Medical Qualifications Examinations for 1959 are scheduled for 17 February and 22 September. To be admitted to these examinations the candidate is required to present, 3 months in advance, an application and credentials confirming that he has had 18 years or more of formal education at least four of which have been in a recognized school of medicine.

Other sponsoring organizations of the examinations are the Association of American Medical Colleges, the American Hospital Association, the American Medical Association, and the Federation of State Medical Boards of the United States.

Cytoanalyzer

Successful results from the first clinical trial of the Cytoanalyzer, an electronic device for sorting specimens of vaginal fluid in the cell examination test for uterine cancer, were reported on 14 November at the annual meeting of the Inter-Society Cytology Council in New York. John C. Pruitt of the National Cancer Institute gave the results of developmental studies from two reports prepared by himself and colleagues in the institute's Field Investigations and Demonstrations Branch.

The Cytoanalyzer is designed to detect abnormal cells by microscopically scanning slides bearing fluid from the vaginal tract. In the current study, 1075 negative slides and 20 positive or suspected-positive were fed into the ma-

chine. The machine was so adjusted that about 40 percent of the known negative slides were correctly eliminated as totally negative. Only those not eliminated by the machine would have had to be examined by cytotechnicians.

Reduction of error in the electronic selection was accomplished by a new method of preparing vaginal-cervical specimens for machine scanning. This method allows the instrument to scan each cell and record the results.

German Hydrographic Institute

The founding of the German Hydrographic Institute (Deutsches Hydrographisches Institut) dates back to 1861 when a Prussian Hydrographic Service was established as a section of the Prussian Navy. In 1871 this organization, located in Berlin, was taken over by the German Navy, under whose jurisdiction it remained until 1945, although during the period from 1919 to 1935 certain sections were temporarily transferred to the German Ministry of Communications. At the end of World War II the entire German Hydrographic Service was disbanded. After a short lapse of time, it was reorganized by the Allied Control Council of Germany as a strictly civilian organization with its seat in Hamburg. It was placed under the German Federal Government in 1949 and today operates under the authority of the Federal Ministry of Communications.

Owing to the circumstances under which its postwar reorganization took place, many sections of the institute had to be set up initially in widely scattered localities. This was felt to be a severe handicap; therefore, in 1957 a large new building was erected in Hamburg on a site adjacent to the harbor. This structure houses all the main sections of the institute. The building consists of two wings, one of ten stories and one of six; extensive basement premises occupied by workshops are used for the installation of instruments which are sensitive to temperature and climatic changes.

Twelve subsidiary offices must still be maintained in ports and similar localities for the testing and on-the-spot certification of nautical instruments and for the rendering of specific nautical information to local shipping interests. There is also a geomagnetic observatory maintained in open country at Wingst (about 60 miles from Hamburg in the vicinity of the Elbe estuary). Because of the nature of the work, the observatory must be located at a substantial distance from traffic and industrial disturbances.

The institute is the owner of six survey vessels: *Gauss* of about 850 tons, *Suderoog* of about 155 tons, *Ruden* and *Hooge* of about 100 tons each, and *Atair* and *Wega* of about 70 tons each. The

newest of these vessels is the *Suderoog*, which was put into service in 1957. The institute ships can serve all types of nautical and oceanographic work, such as precision depth sounding, geophysical and marine geological research, testing of nautical instruments, and development and test work on radio and radar navigation. In 1956-57, the *Gauss* made several exploratory voyages preparatory to the German contribution to the International Geophysical Year. The vessel has already completed one voyage in the North Atlantic area allocated to German IGY research during the spring of 1958, and she sailed at the end of July for the second of these voyages.

The general mission of the institute includes all matters of a nautical nature which are of importance to German shipping. One aspect of this work concerns the collection and evaluation of observational data which are to be incorporated in German federal regulations or in charts, manuals, and directories to be supplied to shipping interests. The institute must therefore be able constantly to meet changing demands and, when necessary, perform research. Another aspect of the institute's work is of a more technical nature: its certificate is required for many nautical instruments, and it must therefore be in a position to perform the tests for compliance with the most recent standards.

The institute is headed by a president, at present G. Boehnecke. His staff consists of about 500 persons, of whom about 40 are scientists and engineers; most of the remaining technicians are mechanics, draftsmen, and printers. A large clerical staff is also maintained. Organizationally, the institute is divided into the following seven main sections: Nautical Publications and Nautical Information Service (section head, H. Mertgen); German Sea Chart Work (section head, H. R. Ermel); Nautical Charting and Geodetics (section head, K. Ansorge); Oceanography and Geomagnetism (section head, J. Joseph); Astronomy, including Astrometry, Tidal Movements, and Time Service (section head, H. Horn); Nautical Technology (section head, H. Gabler); and Library, Archives, and Stocks of Publications (section head, Th. Stocks).

The volume and scope of the institute's work are perhaps best reflected by the fact that the total paper consumption for the institute's printed publications is approximately 80 tons per year. In 1957 the chart printing department produced 1.3 million prints and the letter-press printing department about 3½ million. Further, the institute's library is the only one of its kind in Germany and comprises about 60,000 volumes, all dealing with nautical and hydrographic subjects. In 1957, more than 10,000 books and periodicals were circulated.

NIH Awards

Research grants and fellowships totaling \$4,237,521 were awarded during the month of October by the National Institutes of Health. The bulk of the money, \$3,634,177, was in grants for support of research projects concerned with major diseases and basic problems in the medical and biological sciences.

Of the 266 research grants awarded, 86 grants totaling \$641,615 were for new projects, of which more than half were concerned with research in the fields of arthritis, metabolic diseases, and mental health. The grants were made to 146 institutions in 35 states, the District of Columbia, 2 territories, and 7 foreign countries. Research fellowships totaling \$603,344 were awarded to 157 United States citizens for study in 79 institutions in 30 states, the District of Columbia, and six foreign countries.

News Briefs

The Thomas Alva Edison Foundation has given a special award to "World of the Mind" the new radio series on the sciences and humanities that was prepared by Broadcast Music, Inc., in cooperation with the AAAS and the American Council of Learned Societies [See *Science* 128, 292 (8 Aug. 1958)]. The programs have been made available without charge by Broadcast Music. So far, the series has been carried on 527 radio stations. The recognition award was presented on 1 December at the Edison Foundation's annual dinner.

Six American scientists left on 18 November for a 30-day study of neurology in the Soviet Union. The mission, the first of its kind in the field of neurology, is sponsored by the National Institute of Neurological Diseases and Blindness. It was made possible by the agreement of last January between the United States and the U.S.S.R. to exchange missions in various fields. A group of Soviet specialists will make a similar study of neurology in the United States at a later date.

The National Aeronautics and Space Administration has postponed the launching of the next Vanguard satellite until after the first of the year. A study is now being made of ways to increase the reliability of all satellite vehicles, and it is felt that the results of this study should be known before the next attempt to launch a Vanguard is made.

A research center for the study of drugs and their use in the treatment of mental illness was officially opened on 20 November at Saint Elizabeths Hospital,

Washington, D.C. The new Clinical Neuropharmacology Research Center is operated jointly by Saint Elizabeths and the National Institute of Mental Health. Joel J. Elkes, National Institute of Mental Health pharmacologist and former chairman of the department of experimental psychiatry at the University of Birmingham in England, is the director of the center.

* * *

The Custom Translations Club, a profit-sharing organization designed to furnish scientists in all fields with translations of pertinent material from Russian, Czech, and Polish, has just been established by Consultants Custom Translations, Inc., 227 W. 17 St., New York 11, N.Y. Full details about club participation are available upon request; write Steven H. Smith, Manager. Club members are entitled to a 10-percent royalty on resales of translations they order, and may also purchase other translations at a 50 percent reduction in price. Membership entails no obligation—there are no dues or no fees, and no specified number of orders is required.

* * *

A 3-year research program on the learning of mathematical principles will be undertaken at Princeton University under the direction of Robert M. Gagné of the department of psychology, with a grant of \$44,000 from the Carnegie Corporation of New York. The first step will involve an analysis of two different courses in elementary algebra, one a traditional course, the other a modern experimental course. Many studies of mathematics curricula have been undertaken, primarily at the secondary school level, but no significant number of studies of the methods of learning mathematical concepts has been made for many years.

* * *

A new journal, the *Journal of the Experimental Analysis of Behavior*, began publication in January 1958. It appears at least quarterly and is devoted to the original publication of experiments relevant to the behavior of individual organisms. The executive editor is C. B. Ferster of Indiana University Medical Center. Publisher is the Society for the Experimental Analysis of Behavior, Inc. The subscription rate per annual volume is \$12. Orders for subscriptions may be addressed to O. R. Lindsley, Behavior Research Laboratory, Metropolitan State Hospital, Trapelo Road, Waltham, Mass.

* * *

The American Rheumatism Association has recently established a Committee for the Exchange of Information Concerning Faculty Appointees and Fellows. The committee will be pleased to receive information about fellowship and traineeship opportunities and faculty and other staff vacancies, as well as in-

quiries regarding available personnel. Such information and inquiries should be addressed to: Dr. Currier McEwen, New York University College of Medicine, 550 First Ave., New York 16, N.Y.

* * *

The first known object to be sent into and recovered from outer space will have a permanent resting place at the Smithsonian Institution, Washington, D.C. The Army's Jupiter C nose cone that was propelled to an altitude of 300 miles and more than 1200 miles downrange from Cape Canaveral, Fla., on 7 August 1957, was presented to the Smithsonian on 14 November.

* * *

The Atomic Energy Commission has revised its Access Permit Program to provide that, except for nonprofit educational institutions, no free security clearances will be granted to holders of Access Permits after 31 December. From the inception of the Access Permit Program, the AEC has provided to each permit holder 25 clearance requests without charge. The commission will discontinue this policy, and, in general, charge for all security clearances. The present rates are \$385 for each "Q" clearance and \$15 for each "L" clearance.

Grants, Fellowships, and Awards

Biological sciences. Applications are invited for the second annual Turtex scholarship, which was established by the General Biological Supply House, Inc. The \$5000 award is open to any citizen of the United States who is currently, or who has been, enrolled in a graduate school and who is, or is contemplating, continuing study for the doctorate degree in botany, zoology, or biology. Selection will be based upon evidence bearing upon the promise of the applicant as a prospective teacher and research scholar.

The application deadline is 1 February 1959. Application blanks may be requested from the Chairman of the Award Committee, Professor Frank A. Brown, Jr., Department of Biological Sciences, Northwestern University, Evanston, Ill.

Radiological Physics. Applications are now being accepted for Atomic Energy Commission graduate fellowships in radiological physics. The basic stipend is \$2500 for 12 months, plus \$350 for each dependent. Payments of tuition and fees, as well as a travel allowance, are included in the fellowships.

Radiological physics fellowship assignments are made for study at Vanderbilt University, with field training at Oak Ridge National Laboratory or the National Reactor Testing Station; at the University of Rochester and Brookhaven

National Laboratory; and at the University of Kansas or the University of Washington, and the Hanford Atomic Products Operation.

The Oak Ridge Institute of Nuclear Studies, which administers these fellowships for the AEC, has announced an application deadline of 2 January 1959 for appointments that will take effect the following fall. A brochure describing the program and application materials are available from the Radiological Physics Fellowship Office, University Relations Division, Oak Ridge Institute of Nuclear Studies, P.O. Box 117, Oak Ridge, Tenn.

Science teaching. The AAAS is administering the National Science Foundation's new program of summer fellowships for secondary school teachers of science and mathematics. The primary purpose of the 750 awards is to provide an opportunity for secondary school teachers to enhance their effectiveness as teachers through the further study of the subject matter of science and mathematics.

In this new program, a fellow is enabled to pursue individually planned study programs at an institution of his or her choice. Fellows are selected in a national competition. Applications should not be sent to colleges or universities, but directly to the AAAS. A special feature of this program that may be of interest to many teachers is the provision which allows up to three successive summers in which to study under the same award.

Selection of fellows will be made by the foundation solely on the basis of ability. An application may be submitted by any citizen of the United States who (i) now teaches in a secondary school in the United States, its territories, possessions, or the District of Columbia, (ii) will have had by 1 July 1959 not less than 3 years of experience as a full-time secondary school teacher of science or mathematics, (iii) holds a baccalaureate degree or its equivalent, and (iv) intends to continue teaching. For the purpose of this program, a science or mathematics teacher is defined as one who teaches during each school year at least one class in either science or mathematics in a secondary school.

Stipends will be computed at the rate of \$75 per week for each week of tenure. Married fellows will be provided with a dependency allowance of an additional \$15 per week for spouse and \$15 per week for each dependent child. An allowance to aid in defraying costs of travel of the fellow to his fellowship institution and return will be available. The travel allowance will be computed at the rate of 6 cents per mile but may not exceed \$80 in any one summer. Tuition and certain fees assessed and collected from in-

dividuals of similar academic standing will be paid by the foundation.

Application materials may be obtained from the Teacher Program, American Association for the Advancement of Science, 1515 Massachusetts Ave., NW, Washington 5, D.C. Completed materials must be received by the association not later than 19 January 1959. Fellowships will be awarded on 25 March 1959.

Scientists in the News

HARRISON BROWN, professor of geochemistry at the California Institute of Technology, received the \$2500 Albert Lasker Award in Planned Parenthood during the annual luncheon of the Planned Parenthood Federation of America that took place in New York on 19 November. He was honored for his synthesis of scientific data "into a comprehensive picture of the resources man needs to sustain himself" and for his intensive efforts to bring these findings before the public through lectures, articles, seminars with businessmen, and two major books, *The Challenge of Man's Future* and *The Next Hundred Years*. The citation stated:

"Dr. Brown has vigorously developed the central thesis that population limitation is as indispensable to the survival of mankind as the discovery of new sources of energy. He has alerted us to the necessity of coupling birth control with the development of resources and the introduction of public health techniques (i.e., 'death control'), if underdeveloped areas are successfully to make the transition to industrial civilization and hunger and privation are to be eliminated from the world."

VICTOR F. HESS, winner of the Nobel prize for the discovery of cosmic rays, has been awarded Fordham University's Insignis Medal. The medal—a memorial to Saint Ignatius Loyola, the Spanish Nobleman who founded the Jesuit Order—is awarded to Catholic leaders for extraordinary distinction in the service of God through excellent performance in their professions.

Hess has been a member of the Fordham faculty since 1938. At present, as professor emeritus, he is actively engaged in research. He is conducting one of the nation's four laboratories for the testing of radioactivity in the breath of persons whose jobs bring them into contact with radium. This year he completed a study of the distribution above and below ground of the principal ionizing agents in the lower atmosphere.

WORDEN WARING, formerly chemistry group leader in the Semiconductor Development Laboratory of Ray-

theon Manufacturing Company, Newton, Mass., has joined the Fairchild Semiconductor Corporation, Palo Alto, Calif., as head of the chemistry section.

New members of the research staff of General Atomic's John Jay Hopkins Laboratory for Pure and Applied Science, San Diego, are as follows:

FREEMAN J. DYSON, a specialist in the physics of elementary particles, is on leave of absence from the Institute for Advanced Study at Princeton.

ROBERT R. WILSON, specialist in proton-proton scattering, is on leave of absence from Cornell University, where he is professor of physics and director of the Laboratory for Nuclear Studies.

DAVID H. GURINSKY, specialist in liquid metal technology, has served for 11 years as head of the metallurgy division at the Atomic Energy Commission's Brookhaven National Laboratory.

R. OMAR RILETT, formerly associate professor of biology at the University of Buffalo, has taken up his new duties as professor and head of the department of biological science at Illinois State Normal University, Normal, Ill. He succeeds **ERNEST M. R. LAMKEY**, who has retired. Rilett recently returned from a sabbatical, which he spent as visiting investigator at the Pest Infestation Laboratory, Slough Bucks, England.

WALLACE E. FRANK, formerly head of the bioengineering branch of the Franklin Institute Laboratories for Research and Development, has been named executive vice president of the Spitz Laboratories, Yorklyn, Del. Spitz Laboratories, manufacturer of the Spitz planetariums, are at present also working on development of other devices, including a lunar probe simulator for the Army Ballistic Missile Agency at Redstone Arsenal.

D. R. McMILLAN, professor of physics and member of the Emory University faculty for 25 years, has resigned to accept the chairmanship of the department of physics and mathematics at Alabama College, Montevallo.

THEODOSIUS DOBZHANSKY, professor of zoology at Columbia University, will lecture on biology and genetics at the University of Sydney, Sydney, Australia, during 1959-60. Dobzhansky is a geneticist and a specialist in the evolutionary differentiation of species.

VICTOR K. LA MER, professor of chemistry at Columbia, will also go to Australia next year. He will lecture on physical chemistry in the Division of Chemistry, Commonwealth Scientific Industrial and Research Organization, Melbourne.

HANS ERNST, research engineer, has been appointed to the University of Cincinnati's newly created Herman Schneider research professorship in the College of Engineering. For 32 years he was director of research at the Cincinnati Milling Machine Company, from which he retired in 1957.

KENNETH W. PRESCOTT, director of the Kansas City Museum (Mo), has been named by the Academy of Natural Sciences, Philadelphia, Pa., to the new post of managing director of the Philadelphia National History Museum. Prescott is a zoologist whose specialty is ornithology.

The following mathematicians have reported new appointments for the academic year 1958-59.

B. H. BISSINGER, associate professor on leave from Lebanon Valley College, has been awarded a National Science Foundation science faculty fellowship and will spend the year with the statistical research group at Princeton University.

J. B. CHICCARELLI, assistant professor at Fordham University, has received a National Science Foundation science faculty fellowship and will be at New York University.

L. E. PAYNE, associate professor on leave from the University of Maryland, has been awarded a National Science Foundation senior postdoctoral fellowship and will be at Kings College, Newcastle-upon-Tyne, England.

H. A. ANTOSIEWICZ of the National Bureau of Standards, Washington, D.C., has been appointed visiting associate professor at the University of Southern California.

HERBERT BUSEMANN, professor on leave from the University of Southern California, has been appointed visiting professor at Harvard University.

R. K. BUTZ, assistant professor at Colorado State University, has been appointed associate professor at Alabama Polytechnic Institute.

D. G. CHAPMAN, professor on leave from the University of Washington, has been appointed visiting professor at North Carolina State College.

P. G. COMBA, associate professor at the University of Hawaii, will be on leave at the Western Data Processing Center of the University of California, Los Angeles.

BYRON COSBY, Jr., associate professor at the State University of Iowa, has been appointed professor at the University of Texas.

C. H. CUNKLE, associate professor at Dickinson College, has accepted a position as research mathematician with Cornell Aeronautical Laboratories, Inc., Buffalo, N.Y.

The Institute of Radio Engineers has announced that the 1959 W. R. G. Baker Award will be given to RICHARD D. THORNTON, assistant professor of electrical engineering at Massachusetts Institute of Technology, for his paper on "Active RC Networks" that appeared in the September 1957 issue of *IRE Transactions on Circuit Theory*.

In addition, the IRE has named FRANKLIN H. BLECHER of Bell Telephone Laboratories, Inc., Murray Hill, N.J., the recipient of the 1958 Browder J. Thompson Memorial Prize Award for his paper "Design Principles for Single Loop Transistor Feedback Amplifiers," which also appeared in the September 1957 issue of *IRE Transactions*. Both awards will be presented at the annual IRE banquet on 25 March 1959 at the Waldorf-Astoria Hotel in New York, during the 1959 IRE National Convention.

WILLIAM A. McADAMS, emeritus professor of chemical engineering at Massachusetts Institute of Technology, has received the gold medal of the French Institute of Fuels and Energy. The award was established by the institute "to recognize the most distinguished achievements in the utilization of fuels and thermal energy." It was given to McAdams in tribute to "the internationally known works of an eminent engineer from the United States."

RONALD F. STEBBINGS, a British physicist, will conduct research at General Atomic Division's John Jay Hopkins Laboratory for Pure and Applied Science, San Diego, Calif., while on a year's leave of absence from University College, London. He specializes in atomic collision physics.

AARON NOVICK, associate professor at the University of Chicago and a member of the faculty for 11 years, has been named director of the Institute of Molecular Biology at the University of Oregon, effective 1 January 1959. Novick's research interests have been genetics and physiology of microorganisms, reaction kinetic, nuclear measurements, and radiation chemistry.

W. KENNETH DAVIS, vice president of the Bechtel Corporation, San Francisco, and former director of reactor development for the Atomic Energy Commission, has been named winner of the American Institute of Chemical Engineers' Professional Progress Award in chemical engineering. The award will be conferred on 8 December during the 51st annual meeting of the institute in Cincinnati, Ohio. Davis is being honored "for his leadership in the engineering developments of nuclear power."

ROBERT R. NEWELL, emeritus professor of medicine (radiology) Stanford University Medical School, and scientific consultant to the U.S. Naval Radiological Defense Laboratory, San Francisco, has received the Gold Medal of the Radiological Society of North America. The presentation took place during the 44th annual meeting of the society in Chicago's Palmer House, 16-21 November.

Recent Deaths

ISIDORE ARONS, New York, N.Y.; 76; radiologist and former director of the department of radiation therapy at Harlem Hospital; conducted research on the use of citrus flavonoid therapy in cancer; 10 Nov.

BEVERLEY M. BOWIE, Washington, D.C.; 44; assistant editor of the *National Geographic Magazine*, for which he made a trip around the world; had worked in the Department of Agriculture's Bureau of Agricultural Economics; 15 Nov.

A. CLIFFORD CARLTON, Philadelphia, Pa.; 63; director of the Franklin Institute Museum since 1946; formerly curator of geology and mineral industries at the Chicago Museum of Science and Industry; 12 Nov.

WATERS S. DAVIS, Jr., Washington, D.C.; 59; conservationist who helped to develop the conservation districts in Texas and throughout the country; president of the National Association of Soil Conservation Districts, 1950-54; 15 Nov.

WILLIAM A. DAYTON, Arlington, Va.; 73; plant scientist with the Department of Agriculture's Forest Service for 45 years; chief of the Division of Dendrology and Range Forage Investigations since 1942; collaborator with the Forest Service since his retirement in 1955; started and contributed to the Forest Service Herbarium; 20 Oct.

ELIZABETH G. FOX, Newington, Conn.; 74; former president of the National Organization for Public Health Nursing; had taught at the Yale School of Nursing for 19 years; head of Red Cross Public Health Nursing in Washington, D.C.; 1918-30; 14 Nov.

JOHN C. RATHBUN, New York, N.Y.; 76; professor emeritus of Civil Engineering at City College; taught at Antioch College in 1929-30, and at the University of Washington; chairman of the Department of Civil Engineering at the South Dakota School of Mines, 1925-29; worked as a consulting architect for the Philippine Government in Manila, 1912-15, and was assistant principal of Tung Wen Institute in Amoy, China, 1904-06; studied the sway of the Empire State Building for the American Institute of Steel Construction; 12 Nov.

Book Reviews

Population and World Politics. Philip M. Hauser, Ed. Free Press, Glencoe, Ill., 1958. 297 pp.

The Grassland and Fodder Resources of India. R. O. Whyte. Indian Council of Agricultural Research, New Delhi, 1957. v + 437 pp. Illus. \$5.

Although these books were not intended for simultaneous review, I am fortunate in having both at hand. They complement each other well. Both deal with tensions arising from an unbalance without known precedent in the long course of biological history. Both agree that solutions are technically conceivable but point out that the fundamental obstacles are cultural, coming from human values and behavior. One thinks inevitably of the concluding words of Brown, Bonner, and Weir in *The Next Hundred Years*—"whether man can learn to live with man."

The 12 chapters in *Population and World Politics*, including an introduction by the editor, are the outcome of the Thirtieth Institute of the Norman Wait Harris Foundation, held at the University of Chicago in 1954. While the lapse of four years has produced some changes, notably in official Chinese population policy, the discussion is essentially fresh. It is grouped into three parts—"World population and resources"; "Population, levels of living, and economic development"; and "Population policy and politics."

Part I, by Durand, Notestein, and Woytinsky, fully documents the present population explosion. It makes clear the difficulties of long-range projection and the complication arising from the growing, widespread demand for better levels of living. Earth's resources are held to be capable of sustaining a larger population than they now do, if managed with proper skill and prudence. The prospects of anything better than limping progress are pictured as unlikely, however.

Part II, by Kuznets, Hagen, Thomas, and Spengler, is the most technical, but it is eminently valuable for the insight it affords as to practical operation in demography and economics. Available data leave much to be desired, and assumptions—presented with great candor

—are necessary. Even so, it seems clear that no invariant relation between numbers and welfare—or progress—can be safely assumed.

Part III, by Davis, Lorimer, Taeuber, and Wright, is naturally the one of greatest interest to the general reader. It discusses the conditions in the free and Communist "worlds" and in the "underdeveloped" areas now being wooed by both. The phenomena of population are integral to this dynamic situation, but again not in any uniform or predictable way. That they cannot be ignored is certain, and meanwhile the situation is complicated by the absence of reliable information from important areas. Curiously, we are told that the principal population problem of the United States is the overpopulated countries. I doubt whether this rules out the probability that our skill and intelligence in distributing and planning for our own internal population may greatly affect our future position in international affairs.

The volume by Whyte, of the Food and Agricultural Organization of the United Nations, and his Indian collaborators deals with an area classically overpopulated by man and beast, both ultimately dependent upon the vegetable kingdom. Plant life, the source of sustenance, has been sorely punished by the resulting pressure. Besides the obvious effects on yield of overgrazing, the use of manure for fuel, and the accompanying soil depletion and destruction, nutrient values have suffered from changes in botanical composition of herbage.

India possesses what is essentially forest climate, grading abruptly into scrub and desert, without the intervening natural grasslands found in America and elsewhere. But human activity has resulted in the extensive development of secondary grasslands of various types. The forests that remain have, where they are accessible, suffered from uncontrolled grazing and other abuse.

While the ecological relationship of plant, animal, and man is clear and direct, its effective operation is thwarted by religious sanctions that had their origin under earlier and far different conditions of economic necessity. Existing taboos make it almost impossible to bring about any massive reduction in the num-

bers of substandard cattle. But until this is done and nutrient levels are raised, no efforts at genetic improvement can possibly succeed.

The botanical chapters show that India does have a great variety of indigenous and foreign plants which could afford excellent grazing under proper management. Even so, the monsoon climate is such that legume fodder must be available to carry through periods of low pasture production. But capital requirements to remedy mineral deficiencies, as well as the excessive subdivision of landholdings, render such a program exceedingly difficult, even were the cattle population to be streamlined.

Despite the clear evidence of what might be done through the application of existing ecological knowledge, the volume, with its vivid photographs, is as depressing as it is challenging. The potential richness of the great Indian peninsula lies helpless under the weight of cultural inertia whose very sophistication makes it almost proof against change. As an eminent Indian scientist expressed it to me, "The problems of my country are all but insoluble." I have heard much the same comment from an American who has registered great achievements in a troubled foreign land.

Yet this does not justify the abandonment of hope and friendly effort. Much as India might gain from the benefits of Western science and technology, I for one suspect that the West might learn much from her. A good teacher must know how to listen as well as expound.

PAUL B. SEARS
Conservation Program, Yale University

Electrical Discharges in Gases. F. M. Penning. Macmillan, New York; Philips' Technical Library, Eindhoven, Netherlands, 1958. viii + 75 pp. Illus. \$3.

The subject of electrical discharge in gases, now generally denoted by the broader title *gaseous electronics*, received a renewed life in the early 1920's when techniques using pure inert gases and clean electrodes were initiated by G. Holst and E. Oosterhuis at the Philips Research Laboratories, Eindhoven, Netherlands. This work was ably carried forward after 1924 by the brilliant team of F. M. Penning and M. J. Druyvesteyn, who worked on its experimental and theoretical aspects, respectively. Though World War II diverted Druyvesteyn to other work, Penning continued until his retirement and death in 1953.

This book was written by Dr. Penning and appeared posthumously in 1955 in Dutch and has since been translated into French, German, and English; the latter

translation is under review. In a remarkably clear, lucid, and simple, but largely qualitative, fashion, the author presents the cogent factors of gaseous discharge from the basic processes involved through the various types of discharges, including as well a few technical applications. This book is written for the average engineer or person with a college degree based on the physical sciences, and presents in a comfortably readable fashion the elements of electrical discharge in gases, especially as developed during those years when Penning was the experimental leader in the field. This booklet is on a par in character with the monograph series published by Methuen, but is somewhat less technical and of broader scope. Obviously, when it is recognized that the more rigorous treatment of the subject in volumes 21 and 22 of the Springer *Encyclopedia of Physics* of 1956 covers the same scope of information, it is clear that Penning's coverage cannot be more than superficial. Because of its clarity and simplicity and the judicious choice of the most essential elements, this presentation represents a truly remarkable achievement in condensation. It will prove to be of interest and value to those wishing a quick, stimulating preview of this useful and interesting field of knowledge.

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Mathematics and Statistics for Use in Pharmacy, Biology and Chemistry. L. Saunders and R. Fleming. Published under the direction of the Council of the Pharmaceutical Society of Great Britain. Pharmaceutical Press, London, England, 1957. x + 257 pp. Illus. 27s. 6d.

In the words of the authors, this book provides students in pharmacy and other biological subjects with "a short course in mathematics and statistics which assumes very little knowledge of either topic." In reality, it touches upon so many complex subjects in such a limited space that it is not likely to give the unaided reader a working knowledge of either the mathematics or the statistics it covers.

Following two chapters on arithmetic and algebra, chapter 3 introduces analytical geometry, curve forms, and the graphical solution of equations. Chapter 4 covers arithmetic and geometric progressions, series, permutations and combinations, the binomial theorem, and natural logarithms. The next three chapters present the rudiments of differential calculus, the higher derivatives, partial differentiation, and rules of integra-

tion. These lead directly to a chapter on trigonometry including trigonometric identities and trigonometric integrals, differential equations of the type applicable to chemical reactions, radioactive decay, and diffusion. Chapter 10 treats equations and series for describing experimental measurements.

The remaining five chapters are statistical, in each case with a discussion of elementary theory followed by one or more applications in biology, chemistry, or pharmacy. Beginning with the probability concept, the authors discuss the binomial, Poisson, and normal distributions. Following this, in a chapter on the statistical analysis of repeated measurements, the mean, standard deviation, and limits of error are considered. In one chapter on tests of significance and comparison of data by statistical methods, the authors cover in rapid succession the normal deviate test, the *t* test, the variance-ratio or *F* test, the χ^2 test, least-squares regression, correlation coefficients, covariance, and the error of regression coefficients. Some applications of statistics to biological assay and bacteriology (in chapter 14) and to quality control in pharmacy (in chapter 15) complete the text. Derivations of the more important relations, constants, and reference tables are presented in a series of 13 appendices.

On the whole, the examples are well selected and lucidly explained. *Mathematics and Statistics* contains much fundamental material in a concise and well organized, but oversimplified, form—especially in the statistical chapters. It employs a consistent, mnemonic symbology, and appeals to the intuition of the reader. By bringing together in a compact volume many of the mathematical concepts which underlie basic statistical theory, the authors give the reader a better insight into the interrelations of these concepts than he would gain from the usual introductory text in statistics.

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The Brain and Human Behavior. Proceedings of the Association, December 7-8, 1956. vol. XXVI of *Research Publications, Association for Research in Nervous and Mental Disease*. Williams and Wilkins, Baltimore, 1958. xi + 564 pp. \$15.

The student of neurological science will find in this volume a worth-while group of essays on various aspects of the human nervous system. The 21 individual contributions are by outstanding investigators drawn from such fields as

physiology, psychology, pharmacology, electrophysiology, clinical neurology, and neurosurgery. The resulting mélange of vocabulary, constructs, techniques, and methodologies somehow permits the emergence of new and important findings bearing on brain-behavior relations.

The corpus callosum is no longer "silent" but appears to provide facilitation of sensory input to the two hemispheres. The frontal lobes, all important in mediating the higher levels of mentation, are apparently secondary in importance to the temporal and parietal lobes in mediating various personality functions, including the "body schema."

Of considerable medical significance is the fact that certain patients with uncontrolled psychomotor epileptic seizures may be benefited by unilateral anterior temporal lobectomy without serious loss in mentation.

Objective behavioral techniques have now been developed which define operationally a frontal lobe principle in the human brain. This principle is apparently redundant to some extent throughout the cerebral cortex and is disturbed by a 2 to 3 percent lesion (average brain weight is taken to be 1400 grams) or more, regardless of cortical locus. The possibilities of "chemical facilitation" in such cases are as yet unexplored.

The reader will search in vain in this volume for a compelling theory or model of brain functioning. Theory in this field cannot yet successfully integrate empirical fact. Nevertheless, he will welcome the continued sponsorship of such studies through its annual programs by the Association for Research in Nervous and Mental Disease, one of the very few remaining medical societies devoted to bridging the void between modern neurology and psychiatry.

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Physics of Nuclear Fission. Supplement No. 1 of the Soviet journal *Atomnaya Energiya*. Translated by J. E. S. Bradley. Pergamon, New York and London, 1958. vi + 182 pp. Illus. + plates. \$9.

This book, entitled *Physics of Nuclear Fission*, is actually a translation of the first supplement to the Russian journal *Atomic Energy*, in which were published the papers read at a conference on the physics of nuclear fission, held in January 1956 at the Atomic Energy Institute of the Academy of Sciences of the U.S.S.R.

The conference appears to have been an excellent one, and a surprisingly wide range of material is presented in the

form of terse, concise reviews, with extensive references to the Russian and Western literature. A few of the chapter headings will serve to illustrate the subject matter covered: "Nuclear fission theory" (B. T. Geilikman); "Fast Neutron fission cross sections" (U. S. Zamiatn); "Charge and mass distributions of fission products" (A. N. Murin); "Theory of fission of heavy nuclei near threshold" (V. G. Novos); "Fission Neutrons" (B. G. Erozolimskii); "Spontaneous fission of heavy nuclei" (K. A. Petrzak).

Although, as the editors of *Atomic Energy* remark, the problems reviewed in the reports have not been solved in the two years that have passed since the conference was held, it is nevertheless true that this book is in the process of becoming dated. The subject of fission by mesons, for example, is one which is mentioned in the current literature but which is missing from the conference reports.

It is apparent that this book is not directed toward the beginner, who requires selectivity in the material presented to him in order to avoid confusion; it is, rather, for the workers in this field who wish to keep informed of new developments. The book is priced rather high, but this may be due to the high costs of translation. J. E. S. Bradley is credited with the excellent translation.

An interesting feature of the book is the fact that it reveals the state the Russians had achieved in fission physics at the time of the conference; it contains evaluations, by physicists who appear to be very competent, of Russian and Western efforts in this field.

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An Introduction to Medical Mycology.

George M. Lewis, Mary E. Hopper, J. Walter Wilson, and Orda A. Plunkett. Year Book Publishers, Chicago, ed. 4, 1958. xvii + 453 pp. Illus. \$15.

Few books have been as influential as Lewis and Hopper's in furthering the development of medical mycology. The first edition was published in 1939 shortly after an upsurge of interest in mycotic diseases began. It served as an authoritative guide to physicians and research workers who desired to know more about the subject. Subsequent editions have kept pace with the developments in this field and have met the needs for a practical text. The fourth edition has been extensively revised and expanded, with the collaboration of Wilson and Plunkett. Where formerly the greatest emphasis was placed on the cutaneous my-

coses, now the systemic mycoses receive almost equal coverage. Another significant change lies in the long-delayed adoption of the valid names for the dermatophytes. However, an occasional lapse is noted. In Table 8, *Trichophyton niveum* is cited as a species distinct from *T. mentagrophytes*, and on page 214 a separate paragraph is devoted to *Microsporum simiae*, an organism that is considered by most authorities to be identical with *M. canis*.

The subject matter is well organized, lucidly presented, and arranged so that specific information is easily found. After a brief introductory description of the superficial mycoses, most of the etiologic agents are presented in separate chapters. Generally each chapter covers the following topics: etiology, clinical characteristics, differential diagnosis, pathogenesis, mycology, immunologic reaction, prognosis, and treatment. Where necessary, sections on history, geographic distribution, and prophylaxis are included. The 10 chapters on the deep mycoses are presented in a similar manner. Pertinent references are found at the end of each chapter.

In addition, there are sections on the physiology and nutritional requirements of the dermatophytes, the immunology and allergic reactions of the dermatophytes, treatment of the superficial mycoses, immunology and allergic reactions in the deep mycoses, fungus diseases and workers' compensation, fundamentals of elementary mycology, methods of diagnosis, laboratory methods, experimental aspects, and contaminants.

This publication is lavishly illustrated with informative clinical photographs and illustrations of the gross and microscopic characteristics of both pathogenic and saprophytic fungi. Line drawings of the diagnostic features of common molds and yeasts enhance the value of the chapter on contaminants.

The book is bound attractively and is printed in a legible type face on high-quality paper. This edition should prove to be even more useful than its predecessors.

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New Books

Principles of Quantum Electrodynamics. Walter E. Thirring. Translated from the German by J. Bernstein. Academic Press, New York, 1958. 249 pp. \$8.

Reader in Comparative Religion. An anthropological approach. William A. Lessa and Egon Z. Vogt, Eds. Row, Peter-
son, Evanston, Ill., 1958. 611 pp.

Sampled-Data Control Systems. John R. Ragazzini and Gene F. Franklin. Mc-

Graw-Hill, New York, 1958. 340 pp. \$9.50.

A Scientist of Two Worlds: Louis Agassiz. Catherine Owens Peare. Lippincott, Philadelphia, 1958. 188 pp. \$3.

Soviet Research in Crystallography. Chemistry Collection No. 5, vols. 1 and 2. English translation. Consultants Bureau, New York, 1958. 618 pp. vol. 1, \$30; vol. 2, \$100; Set, \$115.

Stellar Populations. Proceedings of the conference sponsored by the Pontifical Academy of Science and the Vatican Observatory, 20-28 May 1957. D. J. K. O'Connell. North-Holland, Amsterdam; Interscience, New York, 1958. 544 pp. \$10.

A Stereoscopic Atlas of Human Anatomy. Section IV, *The Thorax.* View-Master reels 113-122 and 123-132. David L. Bassett. Sawyer's, Portland, Ore., 1958.

The Structure of Steel. A simple explanation for students, engineers, and buyers of steel. Edwin Gregory and Eric N. Simons. Philosophical Library, New York, 1958. 176 pp. \$10.

The Study of the Physical World. Nicholas D. Cheronis, James B. Parsons, Conrad E. Ronneberg. Houghton Mifflin, Boston, ed. 3, 1958. 693 pp. \$7.50.

A Survey of European Civilization. Wallace K. Ferguson and Geoffrey Bruun. Houghton Mifflin, Boston, ed. 3, 1958. 1028 pp. \$8.25.

Systematics of Today. Proceedings of a symposium held at the University of Uppsala in commemoration of the 250th anniversary of the birth of Carolus Linnaeus. Olov Hedberg, Ed. Uppsala Universitets, Uppsala, Sweden, 1958. 243 pp.

Les Techniques et le philosophe. Pierre Dusseaux. Presses Universitaires de France, Paris, 1958. 191 pp. F. 800.

Thirst: Physiology of the Urge to Drink and Problems of Water Lack. A. V. Wolf. Thomas, Springfield, Ill., 1958. 546 pp. \$12.50.

Topologie algébrique et théorie des faisceaux. Publications de l'Institut de Mathématique de l'Université de Strasbourg. vol. XIII. Roger Godement. Hermann, Paris, 1958 (order from Pierre Berès, 681 Fifth Avenue, New York). 291 pp.

What We Must Know about Communism. Harry and Bonaro Overstreet, Norton, New York, 1958. 348 pp. \$3.95. "We have written this book because we had to." The Overstreets feel that the point in time is here when each individual must accept his responsibility and obligation to know the character of this new force (Communism) which "claims the human future as its own," and "to convert such knowledge into awareness of what is at stake and what needs to be done."

An Introduction to the Chemistry of Fats and Fatty Acids. F. D. Gunston. Wiley, New York, 1958. 171 pp.

Mind and Matter. Erwin Schrödinger. Cambridge Univ. Press, New York, 1958. 111 pp. \$2.75.

A Natural History of Inhaca Island, Mozambique. William Macnae and Margaret Kalk. Witwatersrand Univ. Press, Johannesburg, South Africa, 1958. 163 pp. 42s.

Reports

Increasing the Hatching of Eggs of Cyst and Rootknot Nematodes with Nabam

Abstract. Nabam in water solution retards hatching of *Meloidogyne* eggs. In soil nabam increases egg hatching of *Meloidogyne* and *Heterodera tabacum*, indicating that a decomposition product in soil is a hatching factor. Because of this attribute, combining nabam with a nematocide increases control of *Meloidogyne* by exposing more larvae to the nematocide while it is at maximum efficiency.

The hatching of eggs of cyst nematodes, genus *Heterodera*, and the root-knot nematodes, genus *Meloidogyne*, is increased by certain unidentified hatching factors released by roots of susceptible host plants. In addition, larval emergence may be increased by several synthetic organic and inorganic compounds (1).

We report here the effect of nabam (disodium ethylenbis dithiocarbamate) in the presence of soil on the hatching of the eggs of *Meloidogyne* sp. from *Stephanotis floribunda* and *Heterodera tabacum*.

Of more importance than the finding of another hatching factor is the discovery that combining nabam with a nematocide controls rootknot nematodes better than a nematocide alone.

The effect of nabam on hatching of eggs of *Meloidogyne* sp. is shown in the following experiment. The concentration of nabam in tap water was 0.55 g/lit. in this and subsequent experiments. Duplicate samples of eight egg masses were put for 5 days in (i) a water solution of nabam, (ii) a suspension containing 4 g

Instructions for preparing reports. Begin the report with an abstract of from 45 to 55 words. The abstract should not repeat phrases employed in the title. It should work with the title to give the reader a summary of the results presented in the report proper. (Since this requirement has only recently gone into effect, not all reports that are now being published as yet observe it.)

Type manuscripts double-spaced and submit one ribbon copy and one carbon copy.

Limit the report proper to the equivalent of 1200 words. This space includes that occupied by illustrative material as well as by the references and notes.

Limit illustrative material to one 2-column figure (that is, a figure whose width equals two columns of text) or to one 2-column table or to two 1-column illustrations, which may consist of two figures or two tables or one of each.

For further details see "Suggestions to Contributors" [Science 123, 16 (1957)].

of macerated tobacco roots per liter, and (iii) tap water alone. The average number of larvae recovered from each treatment was as follows: nabam, 12 larvae; tobacco root extract, 55 larvae; and tap water, 300 larvae. The nabam in tap water reduced the hatching of the eggs.

In order to test a possibility that nabam in the presence of soil might increase hatching of *Meloidogyne* eggs, the following experiments were made. One lot of infested soil was drenched with nabam solution, one lot was drenched with tap water, and another lot was left dry. Six replicates of 300 g each were made from each lot. The soil was kept moist at room temperature for 10 days. Then emerged larvae were removed by the modified sugar flotation method (2) and counted. The average number of larvae recovered was 587 larvae from each nabam replicate, 167 larvae from each tap water replicate, and 31 larvae from each dry sample.

To see whether results on infested roots were similar to those in soil, five replicates each of bare, infested roots of *Stephanotis floribunda* were immersed (i) in nabam solution with 10 g of uninfested soil added and (ii) in tap water with 10 g of uninfested soil added. The root-soil mixtures were left at room temperature for 10 days. The larvae were then removed by the modified sugar flotation method and counted. An average of 107 larvae were recovered from roots soaked in the nabam-soil mixture, and only 56 larvae were recovered from roots soaked in the tap water-soil mixture.

In the first experiment nabam in tap water depressed egg-hatching. In the two latter tests the same concentration of nabam in the presence of soil markedly increased egg-hatching both in infested soil and in *Stephanotis* roots.

In the suspensions of *Stephanotis* roots in nabam-plus-soil there were not only more larvae, but there were also more free, normal but unhatched eggs. More than 5000 eggs were recovered from each sample of roots soaked in nabam, and only 220 eggs were recovered from each sample of roots soaked in water. This would suggest that nabam or some of its decomposition products, in the presence of soil, causes a dissolution of the adhesive substance enveloping the eggs with

the consequent release of the eggs. The release of the eggs from the egg masses may be an important factor in the increase of hatching, aside from a direct effect of the nabam decomposition products.

Soil drench treatments of infested soil with a nematocide, V-C 13 (O-2,4-dichlorophenyl-O,O-diethyl phosphorothioate) alone and in combination with nabam were made to determine the effect of nabam on control of root infestation by rootknot nematodes. V-C 13 was used at a concentration of 0.25 ml/lit. of tap water. Nabam was used alone and in mixtures containing 0.25 ml of V-C 13 per liter. Each treatment was replicated four times on infested soil. Four days after treatment tomato (*Lycopersicum esculentum* L.) plants were set in the treated soil. The plants were grown in the greenhouse for 36 days. Then the roots were washed free of soil, and an estimate was made of the percentage of infested roots (Table 1). It may be seen that the percentage of root infestation was markedly high with nabam alone and low in the combination of nabam with the nematocide. Nabam in soil causes dissolution of the protective covering of the egg masses and increases egg hatching, both effects exposing two stages of the nematode immediately to the maximum concentration of the nematocide.

Soil containing cysts of the tobacco cyst nematode, *Heterodera tabacum*, was drenched with nabam or water to study effects of nabam on hatching of eggs of this cyst nematode. Eight samples of 300 g each were taken of soil 1, 3, 5, and 7 days after treatment of the soil with nabam. Control samples were from soil treated with water 7 days previous to use. The cysts were screened from the soil, rinsed in tap water, resuspended in tap water, and incubated at room temperature for 14 days. The numbers of larvae from the control and from the several periods of exposure to nabam in soil were as follows: control, 26; taken from treated soil after 1 day, 35; 3 days, 55; 5 days, 91; and 7 days, 131, [LSD ($P=0.05$) - 47]. These data show that

Table 1. Control of rootknot nematode (*Meloidogyne* sp.) on tomatoes with a combination of nabam and V-C 13.

Treatment and conc. (per liter)	Percentage galled roots		
	Test A	Test B	Av.
V-C 13 (0.25 ml)	41	25	33
Nabam (0.55 g)	81	40	60
Nabam (0.55 g) + V-C 13 (0.25 ml)	6	15	10
Untreated	72	28	50

nabam in soil increases hatching of tobacco cyst nematode eggs as it did those of the rootknot nematode. It is also shown that the magnitude of the effect is a function of time because the 5- and 7-day exposures increased the hatch significantly. The data further indicate that the hatching factor or its effect is retained by the eggs and cysts after their removal from the soil, for the hatching took place in tap water after the cysts were removed from the treated soil and thoroughly washed in water.

In a preliminary attempt to determine which fraction of nabam acts as a hatching factor, lots of soil and roots infested with rootknot nematodes were treated with ethylene thiuram monosulfide and ethylene thiuram polysulfide, compounds known to be decomposition products of nabam (3). No acceleration of hatching resulted. The findings by van der Kerk *et al.* (4) that some dithiocarbarnates have growth-promoting properties and Stoddard (5) that nabam, both in solution and in soil, has root-promoting properties suggested that growth-promoting substances might act as hatching factors. However, α -naphthaleneacetic acid and 3-indoleacetic acid did not increase hatching of rootknot nematode eggs.

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9 July 1958

An Infrared Study of the Hydrolysis of a Thiazolidine

Abstract. The hydrolysis in aqueous solution of L-4-carboxy-2,2-dimethylthiazolidine hydrochloride has been followed by infrared spectrophotometry. The absorption curve of the final reaction mixture had absorption characteristics which were also shown by a solution containing stoichiometric amounts of the expected reaction products.

The product obtained when L-cysteine hydrochloride is refluxed in acetone is L-4-carboxy-2,2-dimethylthiazolidine hydrochloride (CDMT) (1). Woodward and Schroeder (2) followed the hydrolysis of L-4-carboxy-2,2-dimethylthiazolidine polarimetrically and showed that

the compound dissociates to form cysteine and acetone. We have examined the dissociation of CDMT in water, using infrared spectrophotometric techniques.

L-4-Carboxy-2,2-dimethylthiazolidine hydrochloride was prepared [MP, 166°C (lit., 163° to 165°C) (1)]. Eastman Spectro grade acetone and cysteine hydrochloride monohydrate from Mann Re-

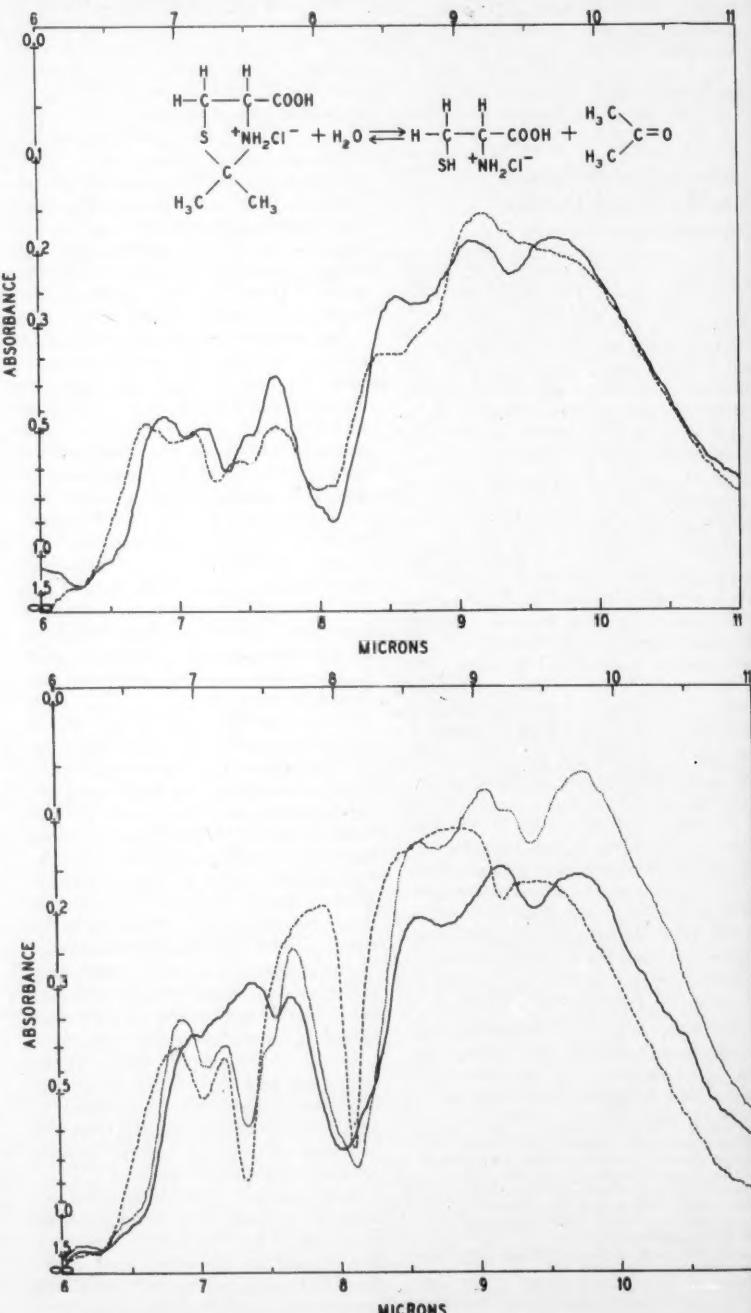


Fig. 1 (top). Curve 1 (dash line) 20 percent (weight by volume) solution of L-4-carboxy-2,2-dimethylthiazolidine · HCl; curve 2 (solid line), hydrolysis mixture after 6 hours. Fig. 2 (bottom). Curve 1 (solid line), 1.750 g of cysteine hydrochloride · H₂O in 10 ml of solution; curve 2 (dash line) 580 mg of acetone in 10 ml of solution; curve 3 (dotted line), cysteine hydrochloride · H₂O-acetone mixture containing the same amounts of solutes as for curves 1 and 2 per 10 milliliters of solution.

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search Laboratories were used. Infrared spectra were obtained on a Perkin-Elmer model 21, double-beam instrument; a barium fluoride cell (0.052 mm) and a transmittance screen in the reference beam (3) were used. The spectrum of water has been published (3), and our spectrum for water corresponds to it.

A 20 percent (weight by volume) solution of CDMT was prepared and scanned as soon as possible after dilution to the mark, scanned again 5 minutes after dilution, and then scanned every 30 minutes thereafter for a total elapsed time of 6 hours. The scanning rate was approximately 30 sec/u. Due to crowding of the curves during the run, only the initial and final curves are shown (Fig. 1), although the pen tracings during the experiment definitely showed progressive differences with time.

Examination of the spectra in Figs. 1 and 2 shows that CDMT has a slight resemblance to both cysteine hydrochloride and acetone. The spectrum of the solution of hydrolysis products (see Fig. 1, curve 2) closely resembles the spectrum obtained for a synthetic mixture prepared in the stoichiometric proportions expected for total hydrolysis (see Fig. 2, curve 3). The curve obtained (Fig. 1, curve 2) indicates that at the end of the 6-hour period the system is at equilibrium and that the point of equilibrium lies very close to total hydrolysis (2).

These data indicate that it is possible, by means of infrared spectrophotometric techniques, to follow the changes which small molecules undergo in aqueous solution if the concentrations of reactants and products are high enough and if their absorption spectra are sufficiently different. Similar experiments along these lines are being pursued.

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27 June 1958

Further Studies on the Relation between Metals and Natural Pigments

In 1955, we published in *Science* an article entitled "Nature of pigments derived from tyrosine and tryptophan in animals" in which the relation between sorts of metals and natural pigments was discussed (1). Shortly thereafter, Goss

Table 1. Amounts of iron, copper, and nickel in animal hair and tissues, in parts per million (dry material). The numbers in parentheses indicate the number of measurements.

Species and tissue	Hair color	
	Black	White
<i>Iron</i>		
Rabbit, hair	30.2 \pm 4.3 (11)	38.1 \pm 5.3 (11)
Mouse, hair	81.0 (1)	56.0 (1)
Pig, hair	173.0 \pm 9.8 (4)	68.7 \pm 2.1 (4)
Guinea pig, hair*	25.3 \pm 0.9 (6)	25.6 \pm 2.6 (6)
Guinea pig, hair†	30.7 \pm 2.5 (2)	31.1 \pm 2.0 (2)
<i>Copper</i>		
Rabbit, hair	17.4 \pm 2.1 (11)	18.6 \pm 2.4 (11)
Rabbit, liver, adult	32.2 \pm 3.6 (6)	26.6 \pm 4.0 (6)
Rabbit, kidney, adult	38.2 \pm 7.3 (5)	30.5 \pm 5.3 (5)
Rabbit, skin, adult, without hair	10.0 \pm 1.5 (3)	9.2 \pm 1.1 (3)
Mouse, hair	17.7 \pm 2.3 (6)	11.3 \pm 1.1 (5)
Mouse, liver, adult	19.4 \pm 4.3 (5)	17.1 \pm 6.9 (5)
Mouse, skin, just after birth	21.6 \pm 3.2 (6)	12.1 \pm 0.7 (5)
Mouse, skin, with hair, 10 days after birth	16.3 \pm 3.2 (2)	6.3 \pm 0.5 (2)
Mouse, skin, adult, without hair	15.3 \pm 2.2 (5)	6.8 \pm 1.8 (5)
Pig, hair	17.1 \pm 1.9 (4)	17.6 \pm 0.9 (4)
Guinea pig, hair*	23.0 \pm 2.0 (3)	23.7 \pm 2.0 (3)
Guinea pig, hair†	19.7 \pm 9.2 (3)	15.2 \pm 4.7 (3)
<i>Nickel</i>		
Rabbit, hair	0.18 \pm 0.08 (2)	1.70 \pm 0.41 (2)
Guinea pig, hair†	trace (1)	trace (1)

* Samples obtained from different animals.

† Samples obtained from the same animal with piebald hair.

according to the genetic background, as well as to the environmental condition, of the individual (5).

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5. We wish to express our sincere thanks to Professor H. Goss of the University of California for his kindness in giving us his valuable advice and criticism.

14 Jun. '58

Pain Sensitivity, Sensory Deprivation, and Susceptibility to Satiation

Abstract. The results reported bear out the hypotheses that (i) pain tolerance is positively related to satiety; (ii) sensory deprivation tolerance is negatively related to satiety. It is inferred that satiety may prove to be in part the mechanism of tolerance and intolerance, and that pain tolerance is inversely related to sensory deprivation tolerance.

Surgery of the brain's prefrontal areas can increase tolerance of pain without altering the perception threshold of pain. This operation of prefrontal lobotomy causes a constellation of changes in measurable aspects of personality (1). The fact that these changes are specifically present after lesions in this area of the brain and not in the four other areas studied, and that there are special types of personality that are most helped by surgery, suggests a relationship between personality and pain tolerance (2). The experiment discussed in this report examines this relationship further, with special emphasis on one variable in the constellation—perceptual satiation—and investigates the tolerance of pain and the tolerance of sensory deprivation as related to susceptibility to satiation.

In relation to an understanding of what underlies tolerance of pain and sensory deprivation, the measurement of satiation phenomena are of particular interest. Satiation was first described by Köhler, who showed that perceptual intensity diminishes after prolonged stimulation with a stronger stimulus (3). Thus, the fact that the size of an object which is touched with the hand appears to diminish after a period of stimulation by a larger object on the same hand is an example of satiation.

Michael Wertheimer (4) has demonstrated the existence of individual dif-

Table 1. Average amount of satiation of four groups of subjects differing in tolerance of pain and deprivation.

Satiation: loss in apparent size of test object (in mm)	Least tolerant				Most tolerant			
	Pain (7 subjects)		Deprivation (4 subjects)		Pain (6 subjects)		Deprivation (5 subjects)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
After 30 sec of stimulation	0.81	2.82	1.26	1.89	2.46	3.60	-0.03	1.92
After total of 90 sec stimulation	-0.42*	2.04	1.74	1.50	3.50*	4.02	-0.12	1.86
After total of 180 sec stimulation	-0.09*†	1.47	4.77†‡	2.22	4.95*	4.20	1.86‡	1.56
After total of 300 sec stimulation	0.96*†	2.31	4.68†‡	2.46	5.28*	4.80	2.04‡	1.41
After 15-minute rest period; no further stimulation	-0.42*†	1.23	2.55†	1.38	4.02*	3.30	1.83	2.67

Differences are significant between those (*) least and most tolerant of pain; (†) least tolerant of pain and deprivation; (‡) least and most tolerant of deprivation.

ferences in susceptibility to this kind of satiation and has shown that this susceptibility is general and independent of the particular department of sense. Visual susceptibility, for example, is correlated with tactile. Klein and Krech have shown that satiation is increased by certain types of brain injury (5).

Eysenck and Nichols have related susceptibility to satiation to the personality dimension called "introversion-extraversion": the more extraverted the personality, the greater his susceptibility to satiation (6). The effect of brain lesions is apparently selective; earlier work in England showed that four operations outside of the prefrontal region, which have no effects on sensitivity to pain, also have no effect on satiability and some other measures related to extraversion (2, 7).

The hypothesis which is thus suggested and to which the study under discussion brings some support is that the individual who tolerates pain best is also most susceptible to satiation. Satiation may indeed prove to be the mechanism of *tolerance* in that an intermittent bigger wave of pain causes subsequent pain to be perceived as less intense. If this is so, high satiability would be a handicap in a situation involving starvation of sensation, as in sensory monotony or deprivation. In such a situation of sensory starvation, susceptibility to satiation may be in part the mechanism of *intolerance* in that it would cause the limited stimulation available to be perceived as less intense. Our findings provide some support for the hypothesis that he who tolerates sensory deprivation least is most susceptible to satiation.

To measure satiation we have used an adaptation of the method of Köhler for kinesthetic figural aftereffect—a method which was later employed by Klein and

Krech (5), by Eysenck (6), and by one of us (A.P.) at the Institute of Psychiatry in London. The subject is blindfolded and feels with the thumb and forefinger of one hand the width of a test object (38.1 mm), a standard block of smooth unpainted wood. With his other hand, also with the thumb and forefinger, he feels a long tapered bar of similar unpainted wood until he finds the place where the bar seems just as wide as the test block. This is the position of subjective equality. The measurements are always made four times in succession.

The subject is then given a wider test block (63.5 mm) to rub with finger and thumb at a constant rate (at the time intervals shown in Table 1). The purpose of this rubbing of a wider block is to induce satiation if it is to occur. The series of periods of rubbing to induce satiation is followed by a series of intervals of rest, with measurement of the test object after each interval. The apparent decrease in size, the measure of satiation, is expressed in millimeters.

For these same subjects we also have measures for pain thresholds, determined in earlier experiments by U. Neisser, formerly of Harvard Psychological Laboratories (8). An adaptation of the Hardy-Wolff-Goodell dolorimeter was used (9). This instrument concentrates radiant heat upon the skin and makes determinable the temperature at which the subject first feels prickling pain and also the temperature at which he can no longer endure the pain. For this second measurement the subject was instructed to endure the pain as long as he possibly could. The difference between these two thresholds constitutes a measure of algic tolerance for the individual subject, a new measure which may be called "pain tolerance."

Tolerance of sensory deprivation was measured in the nine subjects who, during the past 9 months, had volunteered to remain in a tank-type respirator under conditions which resemble those of the original experiment on deprivation in H. O. Hebb's laboratory in Montreal (10). The deprivation investigations were carried out at Boston City Hospital by Liederman, Mendelson, Wexler, Kubansky, and Solomon (11). The time the volunteer remained in the respirator is the measure of tolerance used.

The subjects were 28 adult male students, 19 in the pain group, 9 in the deprivation group. Their ages ranged from 20 to 26.

Table 1 gives a comparison of results for those least and most tolerant of these two forms of stress. We divided the 19 subjects into three groups according to their tolerances for pain; (below 5.5°C, 5.5°C to 8.5°C, and above 8.5°C). The 9 sensory-deprivation subjects were divided into two groups, those that remained less and those that remained more than 6 hours in the respirator. The mean amount of satiation—measured by loss in the apparent size of the object—in those who are most tolerant of pain is significantly greater than in those who are least tolerant of pain. The differences are statistically significant after 60 seconds, 180 seconds, and 300 seconds, respectively, of stimulation. On the other hand, the loss in apparent size of the object for those who are most tolerant of deprivation is significantly smaller than for those who are least tolerant (12). The differences between these two groups are statistically significant after 180 seconds, and 300 seconds, respectively, of stimulation.

In addition, the loss in the apparent size of the object for those who are least tolerant of pain is significantly smaller than for those who are least tolerant of deprivation. After 180 seconds of stimulation, this difference is significant at the .005 level of probability, and it is significant at this level also a quarter of an hour after the cessation of stimulation (13).

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9 July 1958

Occurrence of Lithocholic Acid in Feces of Healthy Men

Abstract. Crystalline lithocholic (3α -hydroxycholanic) acid was isolated from a pooled sample of feces from healthy men for the first time. This acid, which occurs in small amounts in human bile, was obtained by alcohol extraction, followed by solvent partition and chromatography. Under these conditions most of the acid was recovered in the form of its methyl ester.

Of the cholic acids isolated from human bile, chenodeoxycholic ($3\alpha,7\alpha$ -dihydroxycholanic) acid and cholic ($3\alpha,7\alpha,12\alpha$ -trihydroxycholanic) acid are the most abundant. Deoxycholic ($3\alpha,12\alpha$ -dihydroxycholanic) acid was found in smaller amounts, but lithocholic (3α -hydroxycholanic) acid only rarely and in very small amounts (7). Little isolation work has been reported on the bile acids of human feces, but they are known to contain cholic (2) and deoxycholic acid (3). The occurrence of lithocholic acid in human feces has not yet been described. This bile acid was first found in gallstones of cattle by Hans Fischer in

1911 (4) incidental to his work on bilirubin. In the course of an extensive investigation of the lipid fraction of human feces (5), we have isolated lithocholic acid in pure form.

The isolation procedure involves a separation scheme similar to the one used by Dobriner *et al.* (6) for the isolation of steroids from urine. Fifty kilograms of fresh stool from about 20 healthy men was homogenized in ethanol containing 1 mole of hydrochloric acid per liter at 50°C for 7 hours, filtered, and concentrated in a vacuum. The concentrate was dissolved in 15-percent ethanol and extracted with chloroform. Acidic material was separated from the chloroform solution by extraction with 2N sodium hydroxide, and the neutral material was partitioned between 80-percent ethanol and petroleum ether. The material in the alcohol phase was separated into a ketonic and a nonketonic fraction by use of Girard's reagent, and the nonketonic fraction was separated into an alcoholic and a nonalcoholic fraction via the hemiphthalates.

The acidic fraction was subjected to a counter-current distribution in an *n*-heptane/97.5-percent aqueous acetic acid system (7), and a fraction of the aqueous phase was chromatographed on Celite, the solvent system of Matschiner *et al.* (8) being used. The fraction eluted with petroleum ether crystallized from aqueous ethanol and gave an infrared spectrum (9) which indicated the presence of lithocholic acid. Upon recrystallization from aqueous ethanol and again from aqueous acetic acid crystals of mp 176° to 181°C (10) [reported, 185° to 186° (11)] were obtained, which gave an infrared spectrum identical with that of authentic lithocholic acid. In another experiment the chromatographic fraction containing lithocholic acid was treated with diazomethane for conversion into the methyl ester. The latter was purified by chromatography on silica gel by the method of Wootton (12) and yielded a fraction which on recrystallization from aqueous methanol afforded crystals melting at 79° to 84°C (labile form). Methyl lithocholate, prepared, chromatographed, and crystallized as above, melted at 82° to 85°C [reported, 90° to 93°C (13)] and gave an infrared spectrum identical with that of the methyl ester of the isolated specimen. Alkaline hydrolysis of this material, followed by recrystallizations from aqueous ethanol and aqueous acetic acid, afforded crystals of mp 182° to 185°C. This substance showed no depression of the melting point upon admixture with authentic lithocholic acid and had the same infrared spectrum as the authentic acid.

The major portion of the lithocholic acid was isolated from the neutral fraction. When the neutral nonketonic alcohols

were acetylated and chromatographed on alumina, by the method of Reichstein (14), the methyl ester of 3α -acetoxycholanic acid was obtained. The compound, rechromatographed and recrystallized from ether-petroleum ether, crystallized in oblong leaflets, mp 132° to 134°C [reported, 134° (15)]. The substance showed no depression of the melting point upon admixture of authentic methyl 3α -acetoxycholanic acid and gave the same infrared spectrum as the authentic ester. The analysis (16) showed C, 75.15%; H, 10.47 (calcd. for $C_{27}H_{44}O_4$: C, 74.95%; H, 10.25) and $[\alpha]_D^{20} + 48.6^\circ$ in acetone (reported, $[\alpha]_D^{15} + 48.4 \pm 3^\circ$ (15)). Saponification of this acetate with sodium methoxide gave the methyl ester of lithocholic acid, which crystallized from aqueous acetone in needles, mp 81° to 86°C (labile form) and showed no depression of the melting point upon admixture with authentic methyl lithocholate. The infrared spectrum of the product was identical with that of the authentic material and analysis showed C, 76.89%; H, 10.68 (calcd. for $C_{25}H_{42}O_3$: C, 76.87%; H, 10.84) and $[\alpha]_D^{20} + 30.9^\circ$ in acetone (reported, $[\alpha]_D^{15} + 32.8 \pm 2^\circ$ (15)).

While the methods employed do not permit an accurate quantitative determination of the amount of lithocholic acid present in human feces, it is estimated that they contain approximately 3 g/100 kg of wet weight, a concentration which is in the order of that in bile (17). Our methods give no indication of the form in which lithocholic acid is excreted, and further work will be required to account for the isolation of its methyl ester.

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Method for Determination of Oxygen-18 Content of Inorganic Phosphate

Abstract. The reaction of inorganic phosphate and mercuric cyanide at temperatures from 240° to 300°C leads to the quantitative conversion of the phosphate oxygens to carbon dioxide. This report describes the proper conditions for the advantageous use of this reaction for the determination of the oxygen isotope composition of the inorganic phosphate.

The mechanism of several enzymatic reactions has been successfully investigated through use of O¹⁸ as an isotopic tracer. Various phosphorylation reactions involving the transfer of oxygen between inorganic phosphate or phosphate derivatives and organic substrates have been particularly susceptible to analysis by this technique. These analyses invariably involve the determination of the O¹⁸ content of inorganic phosphate, and although the available methods for inorganic phosphate O¹⁸ determination give satisfactory results, they suffer from mul-

tiple disadvantages. The dehydration method (1), based on the pyrolysis of inorganic phosphate to H₂O and pyrophosphate, followed by equilibration of the H₂O with CO₂, is lengthy and time-consuming. Furthermore, since this method involves dilution of the phosphate oxygens, relatively large amounts of phosphate are needed for accurate determinations. A second general analytical method involves heating carbon and inorganic phosphate at 1350°C to yield CO (2). This method requires an elaborate apparatus and has the disadvantage that the product, CO, is not easily separable from air and has the same mass as N₂.

A procedure has been developed in this laboratory which largely circumvents these disadvantages (3). The method is similar to that developed by Rittenberg and Ponticorvo for the determination of O¹⁸ in organic compounds (4). The modified method involves heating KH₂PO₄ and Hg(CN)₂ (5) in a sealed tube for 1 hour at 250°C. Under these conditions, the phosphate oxygens are converted to CO₂ without dilution. The CO₂ is collected and subsequently introduced into the mass spectrometer (6). The original Rittenberg-Ponticorvo method, as developed for organic O¹⁸ determination, is not applicable to inorganic phosphate because of oxygen exchange reactions with the glass container (7).

The procedure is as follows: 1- to 50 mg samples of KH₂PO₄ are placed in break-seal tubes, as described by Rittenberg and Ponticorvo (4). The tubes are dried at 100°C under reduced pressures. Each break-seal tube is then thickened a short distance from the open end and cooled, and 25 mg of dry Hg(CN)₂ is introduced. The tube is evacuated to a final pressure of 7 to 10 μ -Hg, sealed, and heated at 250°C for 1 hour.

The CO₂ formed in the sealed tube is collected in the apparatus shown in Fig. 1. Following the introduction of the sealed tube and the assembly of the apparatus, the whole system is evacuated to a pressure of 7 to 10 μ -Hg without liquid N₂ over the second U-tube trap. Following evacuation, stopcock A₁ is closed, and the break seal is broken with

the aid of the magnet. Stopcock C is then closed, trap 2 is immersed in liquid N₂, and stopcock A is opened to allow CO₂ to distill into trap 2. Any HCN which is formed is frozen out in the Dry-Ice acetone trap (trap 1). After 3 or 4 minutes, stopcocks B₁ and B₂ are closed and stopcock C is opened to evacuate any gas not frozen out in liquid N₂. Stopcock C is then closed, and trap 2 is removed from the apparatus and connected to the mass spectrometer.

The results of a series of determinations are given in Table 1.

In a large number of determinations, the results were extremely consistent. The O¹⁸ concentration of KH₂PO₄ over a range of from 2 to 50 mg of the salt could be determined with a deviation of ± 0.5 percent. Furthermore, it would appear that the heating conditions do not have to be reproduced to any high degree of consistency. Over a temperature range of 230° and 300°C and a time range of 40 minutes to 2 hours, identical O¹⁸ values were obtained.

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27 June 1958

Nuclear Sex of Patients with Testicular Tumors

Abstract. In view of the occurrence of tumors of the testis of "female" nuclear sex, the cells of the hosts of such tumors have been examined. The nuclear sex of a series of 75 such patients was found to be uniformly "male."

The introduction by Barr and Bertram (1) of a reliable technique for cytological determination of the chromosomal sex of an individual has had widespread repercussions in human pathology. One of the most interesting developments has been the discovery by Hunter and Lennox (2), amply confirmed by others (3) that teratomas in male patients may sometimes be of female nuclear sex, whereas "male" tumors are not seen in females. It is claimed that testicular tumors are much more common in malde-

Table 1. Effect of varying amounts of KH₂PO₄ on the O¹⁸ concentration as measured in the CO₂.

Sample	Ratio mass 46/44	Atom-percent excess
1 mg KH ₂ PO ₄ ^{18*}	0.026874	1.13
3 mg KH ₂ PO ₄ ^{18*}	0.027445	1.15
5 mg KH ₂ PO ₄ ^{18*}	0.027453	1.15
10 mg KH ₂ PO ₄ ^{18*}	0.027229	1.15
50 mg KH ₂ PO ₄ ¹⁸	0.004072	0.0

* The theoretical O¹⁸ atom-percent excess was 1.2.

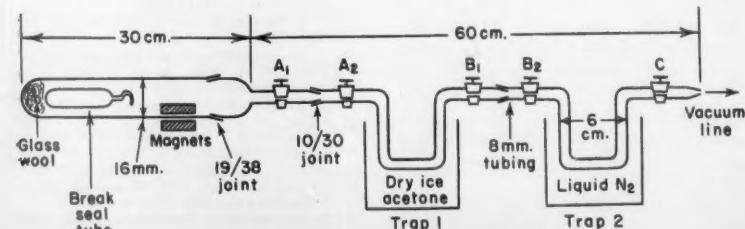


Fig. 1. Apparatus for collection of CO₂.

scended testes than in scrotal testes (4, 5), and two varieties of ovarian tumor, the tubular type of arrhenoblastoma and the dysgerminoma, are often seen in association with the pseudohermaphrodite state (6). It has also been reported that the testes in which tumors develop may exhibit aberrant differentiation in the form of tubules lined by immature Sertoli cells (7).

A study was undertaken of the nuclear sex of patients in whom testicular tumors had developed. Seventy-five cases were taken from the testicular tumor registry at the Armed Forces Institute of Pathology; the criteria of selection were that normal testicular tissue must be present in the sections and that preoperative radiation therapy must not have been employed. Most of the patients were members of the U.S. Armed Forces and were accepted both at their induction physical examination and by their fellows as males; only two showed cryptorchidism. All varieties of germinal testicular tumors were represented in the group; 29 were seminomas, 14 were embryonal carcinomas, 25 were teratocarcinomas, and 7 were of mixed pattern. This distribution of histological types corresponds to that of the much larger series of Dixon and Moore (4).

Sections were stained by hematoxylin and eosin and by the Feulgen technique. In each instance Leydig cells, Sertoli cells, and the cells of the supporting connective tissue were examined. In all cases the nuclear sex was diagnosed as male. In the 25 teratomas, sexing of the tumor was carried out, and 7 contained female elements. These findings indicate that, in the genesis of testicular tumors, little part is played by gross error of sexual differentiation, and that the "crossed sex" teratomas cannot be explained by the thesis that "female" tumors arise in "female" patients.

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5 DECEMBER 1958

Effects of Magnesium and Tetraethylammonium Chloride on the Hypothermic Heart

Abstract. Ventricular fibrillation was induced by the injection of magnesium chloride in isolated canine hearts as well as in intact animals. Ventricular magnesium tolerance was greatly reduced during hypothermia. Defibrillation was achieved by intracoronary injection of tetraethylammonium chloride and electrical shock, even at temperatures as low as 21°C, where it could not be achieved by other means.

Great advances in cardiac surgery have been achieved by the use of induced hypothermia. However, there remains the hazard of irreversible ventricular fibrillation at low temperatures.

In a series of experiments (1) on myocardial excitability in this laboratory, where both a nonfailing isolated canine heart preparation and intact animals were used (2), both at normothermic and hypothermic levels, it was found that magnesium chloride (but not sodium or potassium chloride) in amounts of 1 to 2 milliequivalents injected rapidly into the coronary system invariably produced ventricular fibrillation. The fibrillation threshold to magnesium was greatly reduced during hypothermia.

In a recent publication by Stovner (3) it was shown that a block at the neuromuscular junction produced by an excess of magnesium chloride was released by tetraethylammonium chloride and that the magnesium-induced block was temperature-dependent. This led us to examine the effects of tetraethylammonium chloride on normothermic and hypothermic hearts, with special reference to its effect on ventricular fibrillation. In 22 experiments involving 20 dogs, which included isolated heart experiments as well as single, intact animal experiments, it was found that tetraethylammonium chloride invariably allowed electrical defibrillation at temperatures as low as 21°C, and that defibrillation was achieved with great ease, whereas, without the use of tetraethylammonium chloride, defibrillation could not be achieved. Furthermore, the minimum amount of magnesium required to induce fibrillation was more than doubled after the use of tetraethylammonium chloride under these conditions.

The tetraethylammonium chloride dosages introduced into the coronary system were from 1 to 2 mg/kg of body weight. This dose is small enough to avoid those side effects, such as hypotension and gross electrocardiographic changes, which have been associated with the clinical parenteral dosage of 10 mg/kg of body weight. Other cardiovascular effects of tetraethylammonium chloride observed included decrease of coronary venous

magnesium content and increase of coronary blood flow, as well as a strong positive inotropic action; the last observation confirms previous work by Acheson and Moe (4).

Our results seem to suggest an important role for magnesium in the mechanism of ventricular fibrillation during hypothermia. Its effects might be exerted through a slowing of conduction or by interference with the effect of transmitter substances at the membrane level. Its fibrillatory action is apparently directly antagonized by tetraethylammonium chloride. In addition, tetraethylammonium chloride increases myocardial contractility, probably by increasing coronary flow as well as by acting directly on the muscle.

In four human beings undergoing cardiac surgery for correction of congenital or acquired heart defects under artificial hypothermia, electrical defibrillation of the ventricles has been achieved only after introduction of 1 to 2 mg of tetraethylammonium chloride per kilogram of body weight, by coronary perfusion (5).

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7 July 1958

Ion-Exchange Equilibria on Single Beads

Abstract. Equilibria on single ion-exchange resin beads show that large differences may exist between beads from the same batch. They may be so large that a significant contribution to deviations from ideality can be due to this heterogeneity effect. Correlation between swelling and equilibrium properties shows that bead-to-bead variations are due to differences in cross-linking.

Ion-exchange equilibria on single beads can be studied by radioactive tracer methods (1). Below are given some results for the $\text{Ag}^+ - \text{H}^+$ system on Dowex 50 X-4 resin. The beads were taken from the 20-50 mesh sieve fraction. The tracer was Ag^{110} , obtained by neutron bombardment of silver foil in

the Brookhaven reactor. The temperature was $23^\circ \pm 2^\circ \text{C}$, and the ionic strength was 0.1M.

Besides determination of the equilibrium quotient κ for the reaction



measurements were made of the volumes of the beads by means of a microscope with a calibrated ocular micrometer.

Figure 1 shows the "equivalent" volumes and equilibrium quotients for three different beads plotted against the mole fraction of silver in the resin. Although the data for a given bead may show a spread as large as 20 percent, the variation from bead to bead is much larger—in fact almost 170 percent in "equivalent" volume and 260 percent in equilibrium quotient. There is also a correlation between the swelling and the equilibrium quotient: the larger the "equivalent" volume, the smaller the equilibrium quotient. This is what is to be expected if the degree of cross-linking is different for different beads, and it is very likely that, to a first approximation, bead-to-bead variations are due to differences in cross-linking.

Thirty-six different beads were studied. Values for the experimentally determined equilibrium quotient centered around 2.5 and 4.7, with a spread from 1.8 to 6.5. This large spread may be an extreme case; however, it should be emphasized that resins may contain beads with widely different cross-linkings. This is not unexpected in view of the variations in swelling properties noted by several workers in the field (2).

This heterogeneity effect may be of little practical importance. It is impor-

tant, however, for an understanding of the ion-exchange process, that it may sometimes be so large that it contributes significantly to deviations from ideal behavior. When different models such as ion-pair formation, specific and nonspecific interactions, and so on, are discussed, the heterogeneity effect must be eliminated. For basic research with ion exchangers it would thus be very helpful if very homogeneous resins could be made available in the future (3).

ERIK HÖGFELDT*

Department of Chemistry, Brookhaven National Laboratory, Upton, New York

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3. A detailed report on this work is in preparation. The research described in this study was performed under the auspices of the U.S. Atomic Energy Commission and was presented at the meeting of the American Chemical Society held in San Francisco in April 1958. I am grateful to Dr. William Rubin for help with the English text and to Dr. W. C. Bauman and Dr. R. E. Anderson of the Dow Chemical Company for the resin used in the study. Through the courtesy of the Dow Chemical Company a special batch of DVB 4, as homogeneous as possible, is being synthesized, and it will be interesting to see how homogeneous a resin batch can be.
- * On leave of absence from the Department of Inorganic Chemistry, Royal Institute of Technology, Stockholm, Sweden.

23 June 1958

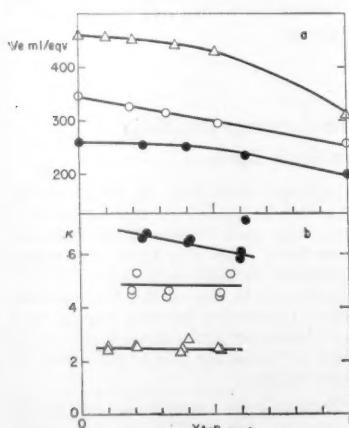


Fig. 1. The "equivalent" volume V_e (a) and equilibrium quotient κ (b) plotted against the mole fraction of silver in resin, X_{AgR} , for three different beads of a batch from a DVB 4 resin. Open circles, bead 1; solid circles, bead 2; triangles, bead 3.

(4) concurred in this explanation but suggested as one of the alternatives the possibility that NO_3^- , Br^- , and I^- might act on the muscle by reducing the activation energy of the contractile process. As far as we were aware this proposition had not been directly tested, and it was the object of the investigation described in this report (5) to evaluate this idea with respect to the contractile velocity of the isolated rat's ventricle.

In the succeeding portions of this report the influence of anions on the activation energies of contraction and relaxation is described. These energies were tested by studying the velocities of contraction and relaxation as a function of temperature. The use of shortening velocity as the mechanical counterpart of the rate of liberation of chemical energy can be justified formally by two successful models of muscular contraction: Hill's (6) and Polissar's (7). In Hill's equation for muscular shortening

$$v(P+a) = b(P_0 - P) \quad (1)$$

the constant b , having the dimensions of velocity ($\text{muscle-length} \times \text{sec}^{-1}$) increases rapidly with temperature, the Q_{10} being about 2.05 for frog muscle in the range between 0° and 10°C (6). The value of a (g wt/cm^2 of muscle cross-section) can, according to Hill, be derived from force-velocity as well as from heat-length data. The velocity of contraction in Polissar's (7) kinetic model is the mechanical counterpart of the net reaction rate of $L \rightarrow S$ in which L and S are the long and the short configurations of the contractile elements, respectively. Similarly, the speed of relaxation is an expression of the kinetics of conversion of $S \rightarrow L$. The two reactions are assumed to proceed by different metabolic paths, the initial stages of each process being sufficiently characterized by first-order kinetics.

Strips from the right ventricles of young adult Slonaker-Wistar rats, unselected as to sex, were prepared as described in earlier publications (8, 9). They were mounted on immersible electrodes and maintained in muscle baths having a capacity of 220 ml. The media used were the "chloride" and the "nitrate" reference solutions, the composition of which has been described (2); in the presence of 100 percent O_2 as the gas phase, the pH of the solutions was 8.3.

The ventricle strips were stimulated at 85 shocks per minute from a constant-current square wave generator (10), the contractions being transduced by a mechanoelectrical myograph consisting of a Statham No. 315 G7A (0.15 ± 0.05 oz) strain gauge. The passive legs of the bridge and the batteries providing the source of the d-c potential were contained in a Statham type CB7 control box which was connected to the gauge

Table 1. Contraction and relaxation velocity constants, Q_{10} values, and activation energies for nitrate and chloride reference solutions.

Anion	T (°K)	$\log_{10} K^*$	$\log K_2 - \log K_1$	Q_{10}	E_a (cal)
<i>Contraction velocity</i>					
NO ₃	300.1	0.9656	0.2541	1.80	10,819
NO ₃	310.1	1.2197			
Cl	300.1	1.0274	0.3125	2.05	13,305
Cl	310.1	1.3399			
<i>Relaxation velocity</i>					
NO ₃	300.1	0.4003	0.4045	2.54	17,222
NO ₃	310.1	0.8048			
Cl	300.1	0.4435	0.4330	2.71	18,436
Cl	310.1	0.8765			

* From equation of the line.

with shielded cable. The ventricle strip was attached to the lever arm of the gauge with nylon thread. As the muscle contracted it changed the resistance of the gauge, and the resulting signal was conducted from the control unit to a Tektronix (model 512) oscilloscope through the d-c input of the instrument. The sweep was triggered by the stimulator, and the oscilloscope traces were recorded photographically on Eastman Tri-X film.

The muscle chambers were immersed in a Precision (D8) serological water bath which was modified for more accurate temperature control by interpolation of an electronic relay responding to

mercury thermoswitches maintained in the bath. These switches were set to operate at 20°, 23°, 27°, 32°, and 37°C with a precision of $\pm 0.2^\circ\text{C}$.

All experiments were made in "flowing" media: the solutions were dripped into the bottom of the muscle bath at a rate of 500 ml/hr, the level being maintained constant by aspiration from the upper surface. After a preliminary equilibration at 20°C for 90 minutes, the resting tension on the muscle strip was adjusted by means of a micrometer to the level giving a maximal contraction. All tests on a given muscle were made against the resting tension value determined at the 20°C point. After the appropriate records had been made at 20°C the temperature was raised and similar recordings were made successively at the higher temperatures, the muscle being allowed to equilibrate for 15 minutes at each temperature before the record was made. The dependence of contraction amplitude on temperature for both the chloride and the nitrate series is described by a parabola having a maximum at 27°C, confirming earlier studies made in "chloride" reference solutions (9, 11). In order to obtain values that were independent of amplitude, the velocity constants of contraction and relaxation were calculated by dividing the slopes of the linear portions of the ascending and descending limbs of the wave by the amplitude of the curve, and by correcting the values appropriately for the time scale and tension calibration. The common logarithms of these constants were plotted against the corresponding reciprocals of absolute temperature, and a line was fitted to each array of contraction or relaxation data by the method of least squares (Fig. 1). The regressions were tested for reliability by the method of Snedecor (12), and each line was found to represent a

discrete array of data. The t values, calculated from the ratios of the slopes to their standard errors, were as follows: nitrate contraction, 28.33; relaxation, 11.77; chloride contraction, 24.18; relaxation, 17.05. The P values corresponding to these figures were less than .01 in each case.

The activation energy for each category was computed by means of the usual form of the Arrhenius equation in which E_a is the activation energy in calories, R is the gas constant, and T is the absolute temperature

$$\log \frac{K_2}{K_1} = \frac{E_a}{2.303R} \left(\frac{T_2 - T_1}{T_2 T_1} \right) \quad (2)$$

using the values of K taken from the regression lines. Calculations of Q_{10} between 27° and 37°C are presented for reference, along with the activation energy data, in Table 1.

The data show a small but statistically significant reduction in the activation energy of contraction and relaxation when nitrate is substituted for chloride in the reference solution. Although the reduction in activation energy appears to be real, we feel that other factors such as the possible increased duration of excitability, produced by the slowing in the transmembrane Na transport, are of greater primary importance in explaining the potentiating effects of nitrate than its influence on the activation energy.

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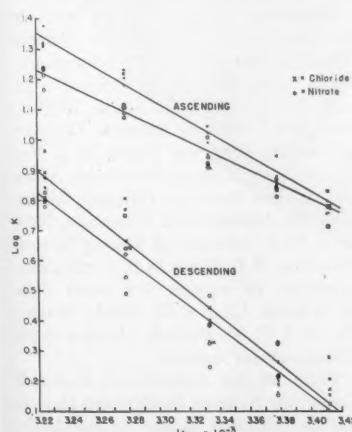


Fig. 1. Relationship between the logarithms of the velocity constants ($\log K$) and the reciprocals of the absolute temperature. The regression equations corresponding to the several lines are: ascending Cl, $\bar{y} = 11.0214 - 3.002x$; ascending NO₃, $\bar{y} = 9.199 - 2.475x$; descending Cl, $\bar{y} = 13.877 - 4.033x$; descending NO₃, $\bar{y} = 12.755 - 3.709x$.

Association Affairs

Preview of Programs at AAAS Washington Meeting

Section and society programs in industrial science, education, and science in general, to be presented at the Washington meeting, are given here. Programs in mathematics, physics, chemistry, astronomy, geology and geography, the biological sciences, anthropology, psychology, the social and economic sciences, the history and philosophy of science, engineering, agriculture, and the medical sciences (including dentistry and pharmacy) have been previously announced.

Industrial Science

Section P. Symposium: "Industrial Science Today: A Status Report on the Satisfaction of Basic Human Needs through Modern Science and Technology"; arranged by Allen T. Bonnell, Drexel Institute of Technology; 29 Dec.; Frank C. Croxton, Battelle Memorial Institute, presiding. Papers by C. G. King, Nutrition Foundation, New York; Preston G. Hoff, E. I. du Pont de Nemours & Company; Edmund Claxton, Armstrong Cork Company; and Floyd S. Daft, National Institutes of Health.

Industrial Science Award Dinner; 29 Dec.; Allen T. Bonnell, presiding.

Society for Industrial Microbiology. Contributed papers, jointly with the Washington Section of the Society for Industrial Microbiology, cosponsored by Section P (Industrial Science); 27 Dec.; Walter N. Ezekiel, Bureau of Mines, presiding. Four papers will be presented.

Symposium and panel discussion, jointly with the Washington Section, cosponsored by Section P (Industrial Science), the American Institute of Biological Sciences, and the American Astronautical Society: "Microbiology in Outer Space Research"; 28 Dec.; Orr E. Reynolds, Office of the Assistant Secretary of Defense, presiding. Papers by Walter N. Ezekiel; R. D. Gafford, Martin Company, Denver, Colo.; Robert W. Krauss, University of Maryland; Alton E. Prince and Sam Bakanauskas, Wright Air Development Center; and Charles P. Sonett, Ramo-Wooldridge Corporation, Los Angeles, Calif.

Education

Section Q. Two sessions of contributed papers, jointly with the Council for Exceptional Children; 26 Dec.; arranged by Norman G. Haring, University of Maryland. Session I, Norman G. Haring presiding; session II, Harold Williamson, U.S. Office of Education, presiding. Nine papers will be presented.

Three sessions of contributed papers; 29 Dec. Session I, Herbert A. Smith, University of Kansas, presiding; session II, P. G. Johnson, Cornell University, presiding; session III, Herbert A. Smith presiding. Fourteen papers will be presented.

Four sessions of contributed papers, jointly with the American Educational Research Association; arranged by Herbert S. Conrad, U.S. Office of Education; 30 Dec. Session I, Herbert S. Conrad presiding; session II, Edward K. Weaver, Atlanta University, presiding; session III, Sam M. Lambert, National Education Association, presiding; session IV, Harry A. Cunningham, Kent State University, presiding. Twenty-three papers will be presented.

Vice-presidential address: "A Few Significant Factors in the History of Science Teaching and Possible Cause and Effect Relationships between These Factors and Present Problems in Teaching Grade and High School Science," by Harry A. Cunningham; 29 Dec.

National Association for Research in Science Teaching. Research symposium; 27 Dec.; arranged by Thomas P. Fraser, Morgan State College, who will preside. Papers by Betty Lockwood Wheeler, Michigan College; Paul E. Blackwood, U.S. Office of Education; Margaret J. McKibben, National Science Teachers Association; William B. Reiner, City of New York Board of Education; John H. Woodburn, Johns Hopkins University; and Herman R. Branson, Howard University; summary by Edward K. Weaver.

National Science Teachers Association. Presentation of science teaching films; arranged by Emery L. Will, State University Teachers College, Oneonta, N.Y., and Wallace Good, Wyandotte High School, Kansas City, Kansas, 27 Dec.

Association programs; 27 Dec.; Her-

bert A. Smith, University of Kansas, presiding. Papers by Herbert A. Smith; John S. Richardson, Ohio State University; and Philip G. Johnson, Cornell University.

Three concurrent sessions; 27 Dec. (A) "General Science"; Berenice G. Lamberton, Washington, D.C., presiding; (B) "Chemistry"; Brother Fidelian, Washington, D.C., presiding; (C) "Physics"; Edward North, Arlington, Va., presiding.

Address and panel discussion: "How Science Teachers Can Help Recognize and Develop Intellectual Resources"; 27 Dec.; Donald G. Decker, National Science Teachers Association, presiding; speaker, Charles E. Bish, National Education Association; panel members, Cecile Finley, Maryland; Abell A. Norris, Jr., Maryland; Sylvia Neivert, New York; and Clifford R. Nelson, Massachusetts.

Symposium for Supervisors and Consultants in Science; arranged by Ralph Keirstead, Hartford, Conn.; 27 Dec.; Ellsworth S. Obourn, U.S. Office of Education, presiding. Papers by Frank W. Brown, New Hampshire Committee for Mathematics and Science; Wayne Taylor, Texas Science Teaching Improvement Program; Franklin D. Kizer, Virginia State Board of Education; Lee E. Boyer, Pennsylvania Department of Public Instruction; and Hugh Templeton, New York Education Department.

Symposium, jointly with the National Association for Research in Science Teaching and Section Q (Education): "New Developments in Science"; arranged by Ellsworth S. Obourn; 28 Dec.; Randall M. Whaley, National Academy of Sciences, presiding. Papers by J. Ned Bryan, North Central Association Study of Talented Students, Chicago; Milton O. Pella, University of Wisconsin; Robert L. Ebel, Educational Testing Service, Princeton, N.J.; Kenneth E. Vordenberg, supervisor of science, Cincinnati Public Schools; Charles C. Smith, Wayne, Pa.; and H. V. Bullock, Georgia State Consultant for Science.

Visits to the Agricultural Research Center, the National Institutes of Health, and the National Bureau of Standards; 29 Dec.

Symposium on the National Defense Education Act of 1958; 29 Dec.; arranged by Robert H. Carleton, National Science Teachers Association, who will preside.

National Association of Biology Teachers. Symposium: "Biology in the Science Curriculum"; arranged by Paul Klinge, Indiana University; 27 Dec.; Dorothy Matala, Iowa State Teachers College, presiding. Papers by Julian L. Solinger, Simmons College; Herman S. Forest, University of Oklahoma; J. David Lock-

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ard, Pennsylvania State University; Rex Conyers, University City, Mo.; Elra M. Palmer, Baltimore Public Schools; and Annie Sue Brown, Board of Education, Atlanta, Ga.

Symposium: "Biology in the Classroom, Laboratory, and Field"; arranged by Paul Klinge; 27 Dec.; Irene Hollenbeck, Southern Oregon College, presiding. Papers by Marvin R. Bell, Indiana State Teachers College; Kenneth B. M. Crooks, Grambling College; William Howenstine, Cleveland Heights, Ohio; Margaret M. Murray, Chicago, Ill.; and Richard L. Weaver, University of Michigan.

Address: "Crucial Competition with Russia in Science Education," by Oscar

Riddle, Plant City, Fla.; 28 Dec.; Irene Hollenbeck, presiding.

Symposium: "What Is Biology"; arranged by Paul Klinge, 28 Dec.; Irving C. Keene, Brookline, Mass., presiding. Papers by Chester A. Lawson, Michigan State University; Richard E. Paulson, National Science Foundation; and Audrey Pressler, Frederick, Md.

Symposium: "The Advanced Biology Course"; arranged by Paul Klinge; 29 Dec.; John Breukelman, State Teachers College, Emporia, Kansas, presiding. Papers by Phillip Fordyce, Oak Park, Ill.; Lula A. Miller, Washington, D.C.; and William S. Putnam, St. Louis, Mo.

American Nature Study Society.

Three-session symposium: "Fifty Years Ahead"; 27 and 28 Dec.

Part I: "ANSS Looks Ahead in the Light of the First Half Century"; Stanley B. Mulaik, University of Utah, presiding. Papers by E. Laurence Palmer, Ithaca, N.Y.; Joseph J. Shomon, Commission of Game and Inland Fisheries, Richmond, Va.; John Brainerd, Nature Conservancy, Springfield, Mass.; Lester A. Giles, Jr., American Humane Education Society, Boston, Mass.; and Ira N. Gabrielson, Wildlife Management Institute, Washington, D.C.

Part II: "An Action Program for the ANSS during the Next Decade"; S. Glidden Baldwin, Danville, Ill., presiding. Papers by Rex Conyers, University City, Mo.; Verne N. Rockcastle, Cornell University; C. W. Mattison, U.S. Forest Service; and Anne Verne Fuller, Western Michigan University.

Part III: "Creating a Better Nature Study Teaching Environment to Improve Nature Interest in Schools: What Role Can the ANSS Play in the Next Decade?"; Emery L. Will, Oneonta, N.Y., presiding. Papers by Martha Munzer, Conservation Foundation; Edith Curry, La Mesa, Calif.; Roland C. Ross, Los Angeles State College; and Stanley B. Mulaik.

Symposium, jointly with the National Science Teachers Association: "Elementary Science"; arranged by Marjorie Campbell, Washington, D.C., Teachers College, and C. W. Mattison; 29 Dec.; Richard L. Weaver, University of Michigan, presiding. Papers by Robert Hines, U.S. Fish and Wildlife Service; Rudolph Wendlein, U.S. Forest Service; and John T. Gibbs and Irving Milgate, Conservation Foundation.

Annual banquet and address: "Searching for Flamingos on Four Continents," by Roger Tory Peterson, Old Lyme, Conn.; 29 Dec.; Richard Weaver presiding.

Science in General

American Association of Scientific Workers. Conference on the Participation of Women in Science, cosponsored by the American Woman's Association, the Business and Professional Women's Foundation, the National Council of Women of the United States, the National Federation of Business and Professional Women's Clubs (including the D.C. State Federation), and Sigma Delta Epsilon; arranged by Murray Vernon King, American Association of Scientific Workers; 29 Dec.; comprising addresses, discussion, panel workshops, and reports. Speakers and moderators: Elizabeth Wood, Bell Telephone Laboratories; Anne Steinmann, Hofstra College; and Dwight B. McNair Scott, University of Pennsylvania.

Conference on Scientific Communication. Symposium: "Communicating Science in Translations"; arranged by the

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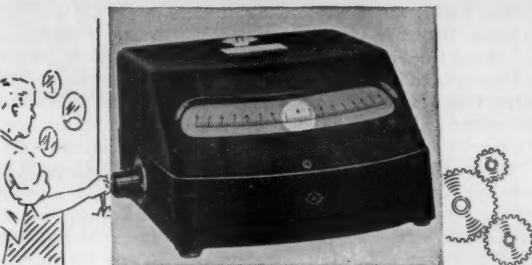
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Society of Federal Translators; 29 Dec.; J. George Adashko (College of the City of New York), editor of *Soviet Physics*, presiding. Papers by Antoinette Pingell, U.S. Naval Research Laboratory; Lillian A. Hamrick, U.S. Department of Commerce; Philip H. Smith, Jr., Georgetown University; and Kay Kitagawa, Library of Congress.

"Communicating Science in Major Programs"; presented by Arnold Frutkin, Special Committee for the International Geophysical Year, National Academy of Sciences; 29 Dec.

Symposium: "Communicating Science in Three Dimensions"; 30 Dec.;

Leonard Rennie, Design and Production, Inc., Alexandria, Va., presiding. Papers by Robert P. Multhauf and George S. Switzer, Smithsonian Institution, and by Axel Horn, New York, N.Y.

Symposium: "Communicating Science in Specialized Libraries"; arranged by the Washington, D.C., Chapter, Special Libraries Association; 30 Dec.; Verner W. Clapp, Council on Library Resources, Inc., presiding. Papers by Frank B. Rogers, National Library of Medicine; John Sherrod, Library of Congress; Burton W. Adkinson, National Science Foundation; and Foster E. Mohrhardt, U.S. Department of Agriculture Library.

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Conference on Scientific Manpower. Two-session symposium, cosponsored by the Engineering Manpower Commission, Scientific Manpower Commission, National Research Council, National Science Foundation, and Section M (Engineering): "The Employment Situation for Scientists and Engineers in 1959"; 30 Dec.

Part I: Henry A. Barton, Scientific Manpower Commission, presiding. Papers by Henry H. Armsby, U.S. Office of Education; Frank S. Endicott, Northwestern University; Phil N. Scheid, Hughes Aircraft Company; Clarence H. Linder, General Electric Company; Robley Winfrey, Bureau of Public Roads, Washington, D.C.; and Ray C. Maul, National Education Association.

Part II: G. E. Arnold, Engineering Manpower Commission, presiding. Papers by N. J. Oganovic, U.S. Civil Service Commission; William H. Chartener, McGraw-Hill Publishing Company; and Irving H. Siegel, U.S. Council of Economic Advisors.

International Geophysical Year. Three-session symposium, joint program of the AAAS and the U.S. National Committee for IGY of the National Academy of Sciences-National Research Council, cosponsored by the American Geophysical Union: "International Geophysical Year Results"; arranged by a committee, Hugh Odishaw, National Academy of Sciences, chairman; 29 and 30 Dec.

Part I: "Arctic and Antarctic"; Hugh Odishaw presiding. Papers by Carl Eklund, U.S. Army Office of Research and Development; George A. Llano, National Academy of Sciences; Troy L. Péwé, University of Alaska; Irene M. Browne, Air Force Cambridge Research Center, Bedford, Mass.; and Kenneth Hunkens, Columbia University.

Part II, cosponsored by the American Astronautical Society and the American Rocket Society: "Rockets and Satellites"; Richard W. Porter, General Electric Company, presiding. Papers by John W. Townsend, Jr., National Aeronautics and Space Administration, and Herbert Friedman, Naval Research Laboratory.

Part III, cosponsored by the American Meteorological Society: "Meteorology, Oceanography, Glaciology"; Harry Wexler, U.S. Weather Bureau, presiding. Papers by Gordon D. Cartwright, U.S. Weather Bureau; F. C. Fuglister, Woods Hole Oceanographic Institution; John Antoine, Columbia University; Sidney Tewkes, U.S. Weather Bureau; William W. Vickers, McGill University; and James Bender, U.S. Army Snow Ice and Permafrost Research Establishment.

Scientific Research Society of America. Annual address: "An Analogy: Individual Education and Industrial Research," by C. Guy Suits, General

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Electric Company; 29 Dec.; George H. Boyd, presiding.

Sigma Delta Epsilon Graduate Women's Science Fraternity. Address: "The Status of American Women Scientists," by Ethaline Cortelyou, Illinois Institute of Technology; 30 Dec.; Mary Louise Robbins, George Washington University, presiding.

Society of the Sigma Xi. Annual address, jointly with the United Chapters of Phi Beta Kappa: "Science and Public Policy," by James R. Killian, Jr., science adviser to the President of the United States; 29 Dec.; Wallace R. Brode, U.S. Department of State, presiding.

Meetings

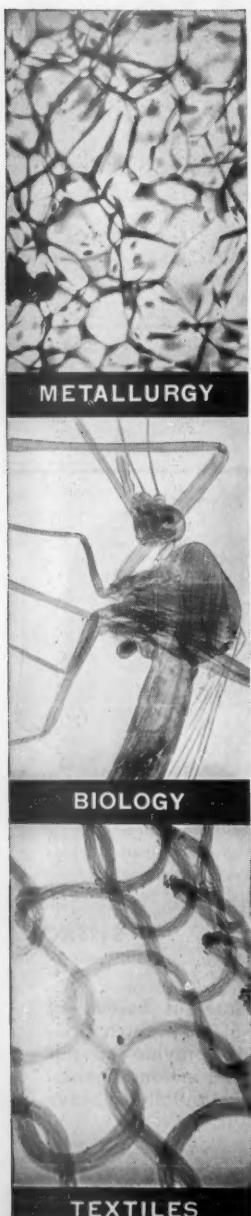
High-Energy Physics

The 1958 annual International Conference on High Energy Physics was held in Geneva, Switzerland, from 27 June to 5 July, under the sponsorship of CERN (Organisation Européenne pour la Recherche Nucléaire) and of the International Union of Pure and Applied Physics. The chairman of the conference was C. J. Bakker, director of CERN. This conference was the eighth of a series of annual conferences on high-

energy physics, of which the first seven were held at the University of Rochester (United States). The more than 300 participants at the 1958 conference included about 100 Americans, 30 British, 20 French, 20 Italians, 20 Russians, and an excellent representation from 25 other countries. A record was probably set in the number of Nobel laureates attending; Anderson, Blackett, Cockcroft, Heisenberg, Lawrence, Lee, McMillan, Pauli, Powell, Yang, and Yukawa were all present.

Various novel organizational procedures were tried at this conference, including two days of organizing sessions (to bring together the contributors and rapporteurs) and a thoroughgoing adoption of the rapporteur system during the plenary sessions. On the whole, these innovations were very successful, and a much more unified picture of the latest theoretical and experimental developments in the high-energy field emerged for most of the participants. The proceedings of the conference (under the editorship of B. Ferretti of CERN) have been published by CERN, Geneva.

There were nine plenary sessions at the 1958 conference, as follows: session 1, on "Nucleon structure" [I. E. Tamm (U.S.S.R.), chairman; W. K. H. Panofsky (Stanford), experimental rapporteur; and S. Drell (Stanford), theoretical rapporteur]; session 2, on the "Nucleon and its interaction with pions, photons, nucleons and antinucleons" [S. I. Nikitin (Dubna), chairman; G. Puppi (Bologna) and O. Piccioni (Berkeley), experimental rapporteurs]; session 3, on the "Nucleon and its interaction with pions, photons, nucleons and antinucleons" [R. E. Peierls (Birmingham), chairman, and G. F. Chew (Berkeley), theoretical rapporteur]; session 4, on "Fundamental theoretical ideas" [W. Pauli (Zurich), chairman]; session 5, on "Strange particle production" [C. C. Butler (London), chairman; J. Steinberger (Columbia), experimental rapporteur, and M. Gell-Mann (California Institute of Technology), theoretical rapporteur]; session 6, on "Strange particle interaction" [D. I. Blokhintsev (Dubna), chairman, M. F. Kaplon (Rochester), experimental rapporteur, and R. H. Dalitz (Chicago), theoretical rapporteur]; session 7, on "Special topics" [T. D. Lee (Columbia), chairman]; session 8, on "Weak interactions: Leptonic modes" [A. Salam (London), chairman, M. Goldhaber (Brookhaven), experimental rapporteur, and L. Michel (Lille), theoretical rapporteur]; session 9, on "Weak interactions: Other modes" [R. E. Marshak (Rochester), chairman, D. A. Glaser (Michigan), experimental rapporteur, and S. B. Treiman (Princeton), theoretical rapporteur]. Sessions 4 and 7 were "classical" theoretical sessions in the sense that original contributions were presented by quite a number of participants.



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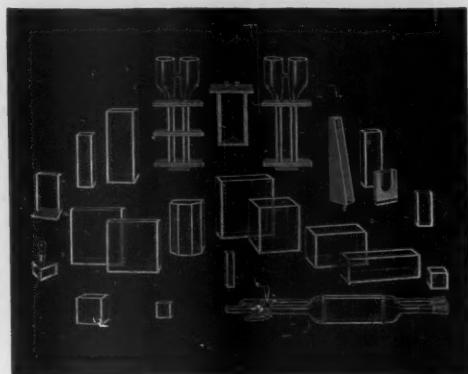
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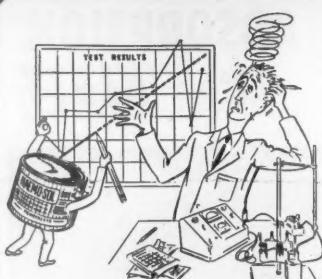
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pants; these included W. Heisenberg (Göttingen), A. Bohr (Copenhagen), and S. B. Okun (Dubna). J. R. Oppenheimer (Institute for Advanced Study, Princeton) gave a summary talk at the end of session 9, assessing the accomplishments of the 1958 conference.

The 1958 high-energy physics conference labored under a handicap in that the three existing multi-Bev machines (the 10-Bev machine in the U.S.S.R. and the cosmotron and bevatron in the United States) had been inoperative for either part or all of the past year. Partly as a result of this, the 1958 conference turned out to be a conservative and reassuring one. There was no report of failure of a well-known conservation law, such as the report of parity breakdown, which highlighted the 1957 conference. There were no new particles reported, such as the hyperons and K mesons which had stolen the show at earlier conferences. Indeed, some of the conservation laws which had shown signs of running into trouble at the 1957 conference seem to be back in operation, and some new particles which had established some faint claims to existence have receded into the "unphysical" region.

Thus, new Berkeley experiments on the production of strange particles in pion-nucleon collisions, when combined with the earlier work of the Michigan group, do not indicate a violation of the law of conservation of isotopic spin (charge independence) (session 5). New Berkeley experiments on the absorption of K⁻ mesons by deuterons are also consistent with charge independence (session 6). Charge independence has been confirmed in pion-nucleon scattering up to 300 Mev, and in the production of pions in nucleon-nucleon collisions up to 660 Mev, at the Dubna Laboratory in the U.S.S.R. (session 2). Recent experiments at Liverpool and Rochester on pion-proton scattering below 100 Mev have helped to straighten out a contradiction with dispersion theory which Puppi and Stanghellini advanced last year (session 2). All attempts to detect parity nonconservation or violation of time-reversal invariance in strong interactions have been negative (session 7).

As far as new particles are concerned, evidence for the 500-electron-mass particle which Alikanyan had reported 2 years ago seems to be disappearing. Alikanyan had claimed that the frequency of the 500-mass particle in the cosmic radiation was about 1 in 200 muons. American and Italian work over the past year has placed an upper limit on the frequency of the 500-mass particle of 1 in 5000 muons (session 5). There also appears to be no evidence for a neutral (isotopic singlet) particle, which is desired by so many theorists (session 2). It is true that the first definite observation of an anti- Λ hyperon

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(in nuclear emulsion exposed to the 4.9 Bev π^- beam at Berkeley), via the $p + \pi^+$ decay mode, was reported, but it would be surprising if $\bar{\Lambda}$ did not exist.

Some other reassuring results were reported to the conference. (i) Quantum electrodynamics holds down to a distance of 0.3×10^{-18} cm, according to the electron-scattering experiments at Stanford (session 1). (ii) New bubble-chamber experiments at Berkeley on the interaction of antiprotons with protons in the energy region from 133 to 333 Mev indicate that the elastic scattering and annihilation parts of the cross section are comparable; this eases the problem of achieving a theoretical understanding of the interaction in question (sessions 2 and 3). (iii) If care is exercised in the application of dispersion theory to various pion-nucleon processes, the renormalized coupling constant always comes out to be about 0.08 (session 3). (iv) The Cornell group has measured the excitation function as well as the angular distribution of the K^+ mesons photo-produced in hydrogen; the linear dependence on the momentum and the isotropic angular distribution probably imply a pseudoscalar K meson (session V).

The conference was conservative in its reaction to various new theoretical ideas which were presented. Thus, Heisenberg's attempt to develop a unified theory of elementary particles on the basis of a nonlinear equation for one spinor particle was subjected to a barrage of criticism. His commutation relations were considered to be too pathological; his indefinite metric was seen as leading, probably, to a violation of microcausality; his degenerate vacuum was thought to be in conflict with present-day field theory; and his use of the Tamm-Dancoff method for computing the masses of the particles was considered too crude. Pauli, who only 6 months ago had associated himself with Heisenberg's theory, turned out to be his most vehement critic. Despite the hostile reception accorded the specifics of Heisenberg's theory, it was generally agreed that his objective was very worth while.

A. Bohr's attempt to present a simple derivation of the dispersion relations on the basis of macroscopic causality also met with an unsympathetic response, particularly because of his failure to give adequate recognition to the nonphysical region in the finite-mass case. The most novel theory presented at the conference, and one which did not meet an immediately negative reception, was that of Okun, who sketched an attempt to deduce the existence of all the baryons and mesons from strong four-fermion interactions among the three baryons: neutron, proton, and Λ hyperon. He showed how certain conservation laws (for example, strangeness-conservation) can be deduced from certain conditions (such as chirality invariance) imposed on the

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original four-fermion interaction. In a general way, Okun's program is similar to that of Heisenberg, except that Okun recognizes that it is probably necessary to start with a minimum of three spinor fields in order to deduce the wealth of conservation laws which seem to hold for the strong interactions.

Probably the greatest progress during the past year in elementary particle physics was registered in the domain of weak interactions (sessions 8 and 9). The last obstacle to the *V-A* (*V*, vector; *A*, axial vector) interaction in beta decay was overcome with a remeasurement of the

electron-neutrino correlation from He^6 (by the Illinois group). All the other new beta-decay experiments definitely favor the *V-A* interaction, and the latest Russian measurement of the neutron lifetime fixes the ratio $A/V = -1.25 \pm .04$. The work at Chalk River and at Argonne National Laboratory on the neutron decay gives no evidence for time-reversal breakdown in weak interactions. It is thus established that the helicity of the neutrino is negative (left-handed neutrino) and that Landau's argument for the invariance of weak interactions under "combined inversion" is probably cor-

rect. The extension of the *V-A* theory to other weak interactions has met with a considerable amount of success, and, in particular, the parity breakdown involved in the decay of the Λ hyperon can be understood on the basis of this extension. These successes have given support to a universal *V-A* theory of weak interactions, first put forward by E. C. G. Sudarshan and R. E. Marshak (on the basis of the "chirality" invariance of the weak four-fermion interaction for each field separately) and, independently, by R. P. Feynman and M. Gell-Mann (on the basis of a two-component theory of the spin $1/2$ particle). Many experiments still remain to be done, particularly in connection with the strange-particle decays, in order to decide whether a universal theory of weak interactions holds.

The time and place of the annual International Conference on High Energy Physics is now regulated by a Commission on High Energy Physics established in 1957 by the International Union of Pure and Applied Physics. Members of this commission [C. J. Bakker (chairman), R. E. Marshak (secretary), W. K. H. Panofsky, R. E. Peierls, I. E. Tamm, and V. Veksler] met in Geneva on 26 June and decided that the next three conferences will be held in Moscow, Rochester, and Geneva, in 1959, 1960, and 1961, respectively, in July of each year. This commission also decided that a biennial international conference on high-energy accelerators and instrumentation will be held in Geneva in 1959, at Brookhaven National Laboratory in 1961, and in Moscow in 1963. Finally, it was decided that, commencing 1 January 1959, a monthly newsletter on high-energy physics (containing abstracts of articles, calendar of meetings, items of general interest, and so on) would be published by CERN under the auspices of the International Union of Pure and Applied Physics.

R. E. MARSHAK

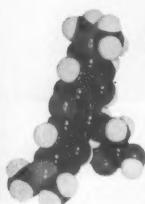
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International Conference on Epidemiology in Mental Disease

An international work-conference on problems in field studies in mental disorders will be held 16-19 February 1959 under the auspices of the American Psychopathological Association, financed by a grant from the National Institute of Mental Health. Meetings will be held at the Park Sheraton Hotel in New York.

The general purpose of this conference is to bring together a group of international authorities in this field to discuss definitions, assumptions, conceptual frameworks, and techniques of data collection and analysis used in working with problems related to the incidence, preva-

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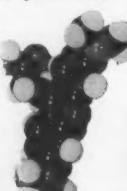
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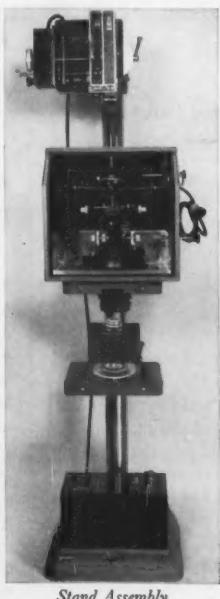
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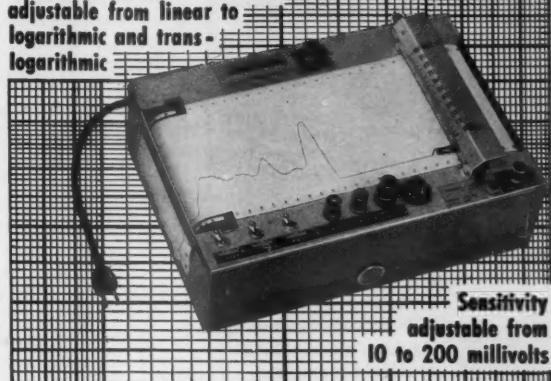
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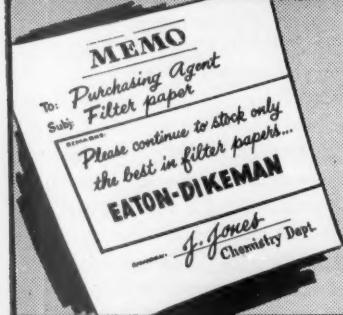
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lence, and outcome of mental disorders. The first day's session will be devoted to problems of taxonomy, the second day's to problems of defining units of study, and the third day's to problems of comparability of field investigations; a summary session will be held on the final day.

Fifteen American and fifteen foreign participants have been invited. Among the foreign participants will be professors Jan Boök of Sweden, Erik-Essen-Möller of Sweden, Aubrey Lewis of England, J. E. Meyer of Germany, Ø. Ødegaard of Norway, Pierre Pichot of France, H. C. Kümke of the Netherlands, E. Stengel of England, Erik Strömgren of Denmark, E. E. Krapf of Switzerland, and D. Reid of England.

At the end of the work-conference, the annual meeting of the American Psychopathological Association will take place. The symposium for this year's meeting (20-21 February) will be on the epidemiology of mental disorders; and some of the findings of this work conference will be reported, including contributions by both foreign and American guests. Topics for the symposium will include current field studies in the mental disorders, current studies of the incidence and prevalence of hospitalized mental patients, current studies of the prognosis and outcome of therapy, and field studies in the etiology of mental disorders. Requests for further information should be addressed to Dr. Joseph Zubin, American Psychopathological Association, 722 W. 168 St., New York 32, N.Y.

International Planned Parenthood

The International Planned Parenthood Federation's sixth international conference will be opened in New Delhi, India, by Prime Minister Nehru on 14 February and will remain in session until 21 February. In addition, the President of India, Rajendra Prasad, will receive those attending the conference at a reception.

"Family Planning—Motivations and Methods" will be the theme of the conference, which will be held under the auspices of the FPA of India. Subjects to be discussed include population in an atomic age, cultural patterns and motivations, biological aspects of fertility control and evaluation of oral methods, laboratory and clinical testing, sterilization, and infertility problems and education for family life.

Visits will be arranged to Ludhiana where a 10-year population study is being conducted under the auspices of the Indian Government, and to the government institutes (demographic, family planning training, and contraceptive testing) in Bombay.

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bright weather is to be expected in Delhi. Visitors are advised to bring warm wraps or coats and medium weight clothing. Registration forms are now available and should be returned *not later than 31 December* to Conference Secretary, FPA India, 1 Metropolitan House, Dadabhai Naoroji Road, Bombay, 1. The official travel agents for the conference are Messrs. Trade Wings Ltd., 30/32 Ram-part Row, Bombay, 1. All requests for hotel accommodations should be made through them, also not later than 31 December.

Forthcoming Events

December

26-31. American Assoc. for the Advancement of Science, annual, Washington, D.C. (R. L. Taylor, AAAS, 1515 Massachusetts Ave., NW, Washington 5, D.C.)

The following 47 meetings are being held in conjunction with the AAAS annual meeting.

AAAS Committee on the Social Aspects of Science (C. D. Leake, Ohio State Univ. College of Medicine, Columbus, Ohio). 27 Dec.

AAAS Cooperative Committee on the Teaching of Science and Mathematics (J. W. Buchta, Univ. of Minnesota, Minneapolis, Minn.). 28 Dec.

Academy Conf. (J. A. Yarbrough, Meredith College, Raleigh, N.C.). 27-28 Dec.

Alpha Epsilon Delta (M. L. Moore, 7 Brookside Circle, Bronxville, N.Y.). 27 Dec.

American Assoc. of Clinical Chemists (Miss E. G. Frame, Clinical Center, Natl. Institutes of Health, Bethesda 14, Md.). 29-30 Dec.

American Assoc. of Scientific Workers (R. J. Rutman, 6331 Ross St., Philadelphia 44, Pa.).

American Astronautical Soc. (R. Fleisig, 58 Kilburn Rd., Garden City, N.Y.). 27-30 Dec.

American Geophysical Union (W. E. Smith, AGU, 1515 Massachusetts Ave., NW, Washington 5).

American Meteorological Soc. (K. Spengler, 3 Joy St., Boston, Mass.).

American Nature Soc. (S. Mulaik, Biology Dept., Univ. of Utah, Salt Lake City). 26-30 Dec.

American Physiological Soc. (F. A. Hitchcock, Ohio State Univ., Columbus).

American Political Science Assoc. (E. M. Kirkpatrick, APSA, 1726 Massachusetts Ave., NW, Washington, D.C.). 27 Dec.

American Psychiatric Assoc. (L. J. West, Univ. of Oklahoma School of Medicine, Oklahoma City 4). 27-28 Dec.

American Soc. of Criminology (D. E. J. MacNamara, Dean, New York Inst. of Criminology, Inc., 40 E. 40 St., New York 16). 27-28 Dec.

American Soc. of Naturalists (J. Schultz, Inst. for Cancer Research, Philadelphia, Pa.).

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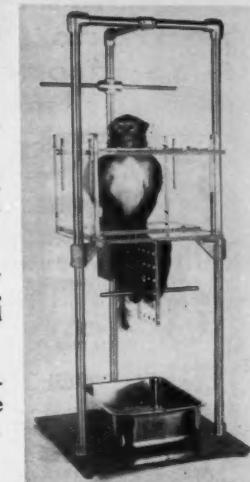
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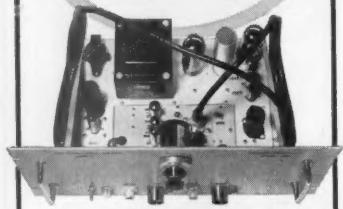
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G. Ray, U.S. Geological Survey, Washington 25). 29 Dec.

American Soc. of Zoologists (G. M. Momen, Dept. of Biology, Goucher College, Towson, Baltimore 4, Md.). 27-29 Dec.

American Sociological Soc. (K. Davis, Inst. of International Studies, Univ. of California, Berkeley 4). 29 Dec.

American Statistical Assoc. (E. Glazer, 305 George Mason Dr., Falls Church, Va.). 30 Dec.

Association of American Geographers, Middle Atlantic Div. (J. E. Guernsey, 9707 Parkwood Dr., Bethesda, Md.). 29 Dec.

Association for Computing Machinery (J. Douglas, Mathematics Dept., Rice Inst., Houston, Tex.).

Astronomical League (Miss G. C. Scholz, 410 Mason Hall Apts., Alexandria, Va.). 26 Dec.

Biometric Soc. (J. Cornfield, Johns Hopkins Univ., Baltimore, Md.). 30 Dec.

Conference on Scientific Communication Problems (G. L. Seelstad, Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.). 28-30 Dec.

Conference on Scientific Manpower (T. J. Mills, National Science Foundation, Washington 25). 30 Dec.

Ecological Soc. of America (D. E. Davis, Johns Hopkins Univ., School of Hygiene, Baltimore, Md.).

History of Science Soc. (M. C. Leikind, 1334 Aspen St., NW, Washington 12). 29 Dec.

Instrument Soc. of America (O. L. Linebrink, Battelle Memorial Inst., Columbus, Ohio.). 30 Dec.

International Geophysical Year (H. Odishaw, National Acad. of Sciences, Washington 25). 29-30 Dec.

Junior Scientists Assembly (K. C. Johnson, Supervising Director of Science, District of Columbia Public Schools, Woodrow Wilson High School, Washington 16). 27-28 Dec.

Metric Assoc. (J. T. Johnson, 694 W. 11 St., Claremont, Calif.).

National Acad. of Economics and Political Science (D. P. Ray, Hall of Government, George Washington Univ., Washington, D.C.). 27 Dec.

National Assoc. of Biology Teachers (P. Klinge, Jordan Bldg., Indiana Univ., Bloomington). 26-30 Dec.

National Assoc. for Research in Science Teaching (E. S. Obourn, U.S. Office of Education, Washington 25). 26-30 Dec.

National Assoc. of Science Writers (J. Billard, U.S. News and World Report, Washington, D.C.).

National Geographic Soc. (W. R. Gray, NGS, 16 and M Sts., NW, Washington 6). 30 Dec.

National Science Teachers Assoc. (W. A. Kilgore, District of Columbia Teachers College, Washington 9). 26-30 Dec.

National Speleological Soc. (W. E. Davies, 125 Greenway Blvd., Falls Church, Va.). 28-29 Dec.

Philosophy of Science Assoc. (C. W. Churchman, Case Inst. of Technology, Cleveland, Ohio).

Pi Gamma Mu (Mrs. Effie B. Urquhart, Winfield, Kan.).

Scientific Research Soc. of America (D. B. Prentice, 56 Hillhouse Ave., New Haven 11, Conn.).

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Sigma Delta Epsilon (Mrs. V. L. Blackford, 2630 Adams Mill Rd., NW, Washington 10). 26-30 Dec.

Society for General Systems Research (R. L. Meier, Mental Health Research Inst., Univ. of Michigan, Ann Arbor). 29 Dec.

Society for Industrial Microbiology, Washington section (W. N. Ezekiel, Bur. of Mines, Washington 25). 27-28 Dec.

Society of the Sigma Xi (T. T. Holme, 56 Hillhouse Ave., New Haven 11, Conn.). 29 Dec.

Society of Systematic Zoology (G. W. Wharton, Dept. of Zoology, Univ. of Maryland, College Park). 26-30 Dec.

United Chapters of Phi Beta Kappa (C. Billman, 1811 Q St., NW, Washington, D.C.). 27 Dec.

Washington Acad. of Sciences (G. W. Irving, ARS, U.S. Dept. of Agriculture, Washington 25).

27-29. American Economic Assoc., Chicago, Ill. (J. W. Bell, AEA, Northwestern Univ., Evanston, Ill.)

27-29. Econometric Soc., Chicago, Ill. (R. Ruggles, Box 1264 Yale Station, Yale Univ., New Haven, Conn.)

27-30. American Folklore Soc., New York, N.Y. (MacE. Leach, AFS, Univ. of Pennsylvania, Philadelphia, Pa.)

28-30. Archaeological Inst. of America, Cincinnati, Ohio. (L. A. Campbell, AIA, Dept. of Classics, Brooklyn College, Brooklyn, N.Y.)

29-30. National Council of Teachers of Mathematics, New York, N.Y. (M. H. Ahrendt, NCTM, 1201 16 St., NW, Washington 6.)

28-30. Western Soc. of Naturalists, Seattle, Wash. (J. P. Harville, San Jose State College, San Jose 14.)

January

6. Society for Applied Spectroscopy, New York, N.Y. (P. Lublin, Sylvania Research Laboratories, Bayside, N.Y.)

7-9. Northeastern Weed Control Conf., 13th annual, New York, N.Y. (E. R. Marshall, Carbide & Carbon Chemical Co., New York, N.Y.)

12-14. Reliability and Quality Control, 5th-natl. symp., Philadelphia, Pa. (W. T. Sumerlin, Philco Corp., 4700 Wissahickon Ave., Philadelphia 44.)

20-22. American Mathematical Soc., annual winter, Philadelphia, Pa. (E. G. Begle, Leet Oliver Hall, Yale Univ., New Haven, Conn.)

21-22. American Group Psychotherapy Assoc., 3rd annual institute, New York, N.Y. (C. Beukenkamp, Public Relations Chairman, 993 Park Ave., New York 28.)

22-23. Mathematical Assoc. of America, 42nd annual, Philadelphia, Pa. (H. M. Gehman, MAA, Univ. of Buffalo, Buffalo 14, N.Y.)

23-24. American Group Psychotherapy Assoc., 16th annual conf., New York, N.Y. (C. Beukenkamp, Public Relations Chairman, 993 Park Ave., New York 28.)

24-29. American Acad. of Orthopedic Surgeons, Chicago, Ill. (C. L. Compere, 720 N. Michigan Ave., Chicago Ill.)

26-29. American Meteorological Soc., New York, N.Y. (K. C. Spengler, AMS, 3 Joy St., Boston 8, Mass.)



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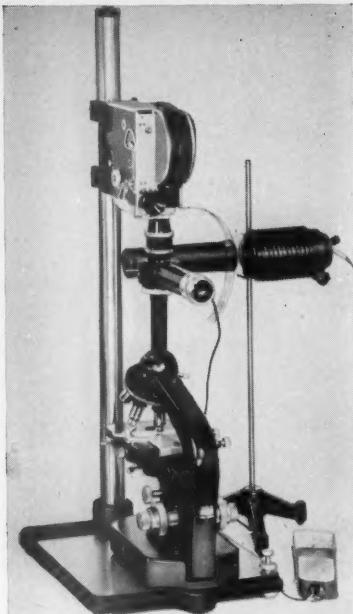
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26-29. American Soc. of Heating and Air Conditioning Engineers, 65th annual, Philadelphia, Pa. (W. M. Vidulich, ASHACE, 62 Worth St., New York 13.)

26-29. Institute of the Aeronautical Sciences, 27th annual, New York, N.Y. (IAS, 2 E. 64 St., New York 21.)

27-30. Society of Plastics Engineers, Inc., 15th annual tech. conf., New York, N.Y. (L. A. Bernhard, SPE, 65 Prospect St., Stamford, Conn.)

28-29. Nuclear Fuel Elements, 1st intern. symp., New York, N.Y. (H. H. Hausner, 1st Intern. Symp. on Nuclear Fuel Elements, 730 Fifth Ave., New York 19.)

28-31. American Physical Soc., annual, New York, N.Y. (E. R. Fitzgerald, Dept. of Physics, Pennsylvania State Univ., University Park.)

29-31. Western Soc. for Clinical Research, 12th annual, Carmel-by-the-Sea, Calif. (W. N. Valentine, Office of the Secretary, Univ. of California Medical Center, Department of Medicine, Los Angeles 24.)

February

1-6. American Inst. of Electrical Engineers, winter general, New York N.Y. (N. S. Hibshman, 33 W. 39 St., New York 18.)

6-7. American College of Radiology, Chicago, Ill. (W. C. Stronach, 20 N. Wacker Dr., Chicago 6.)

9-11. American Acad. of Allergy, Chicago, Ill. (B. Rose, Royal Victoria Hospital, Montreal, P.Q., Canada.)

9-11. Nature of Coal, symp., Bihar, India. (Director, Central Fuel Research Inst., P. O. Fuel Research Inst., Dhanbad District, Bihar.)

11-13. American Acad. of Occupational Medicine, Boston, Mass. (L. Blaney, 1608 Walnut St., Philadelphia, Pa.)

12-13. Solid State Circuits Conf., Philadelphia, Pa. (A. B. Stern, General Electric Co., Bldg. 3, Syracuse, N.Y.)

14. Short Range Navigation Aids, Montreal, Canada. (Intern. Civil Aviation Organization, Maison de l'Aviation Internationale, Montreal.)

15-19. American Inst. of Mining, Metallurgical, and Petroleum Engineers, annual, San Francisco, Calif. (E. O. Kirkendall, AIME, 29 W. 39 St., New York 18.)

16-19. Problems in Field Studies in Mental Disorders, intern. work conf., New York, N.Y. (J. Zubin, American Psychopathological Assoc., 722 W. 168 St., New York 32.)

20-21. Epidemiology in Mental Disorders, annual meeting of the American Psychopathological Assoc., New York, N.Y. (J. Zubin, APA, 722 W. 168 St., New York 32.)

25-26. Midwest Industrial Radioisotopes Conf., Manhattan, Kan. (J. Kitchens, Dept. of Continuing Education, Kansas State College, Manhattan.)

26-28. Genetics and Cancer, 13th annual symp. on fundamental cancer research, Houston, Tex. (Editorial Office, Univ. of Texas, M. D. Anderson Hospital and Tumor Inst. Texas Medical Center, Houston 25.)

(See issue of 21 November for comprehensive list)

Equipment

The information reported here is obtained from manufacturers and from other sources considered to be reliable. Science does not assume responsibility for the accuracy of the information. A coupon for use in making inquiries concerning the items listed appears on page 1470.

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JOSHUA STERN

National Bureau of Standards

SCIENCE, VOL. 128



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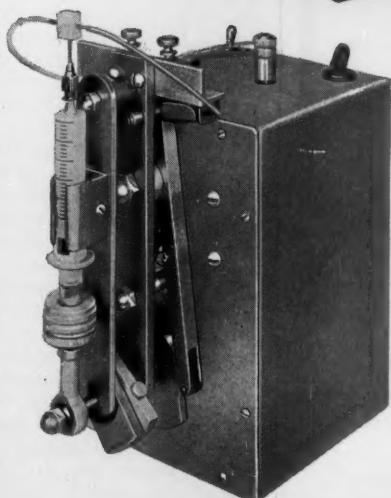
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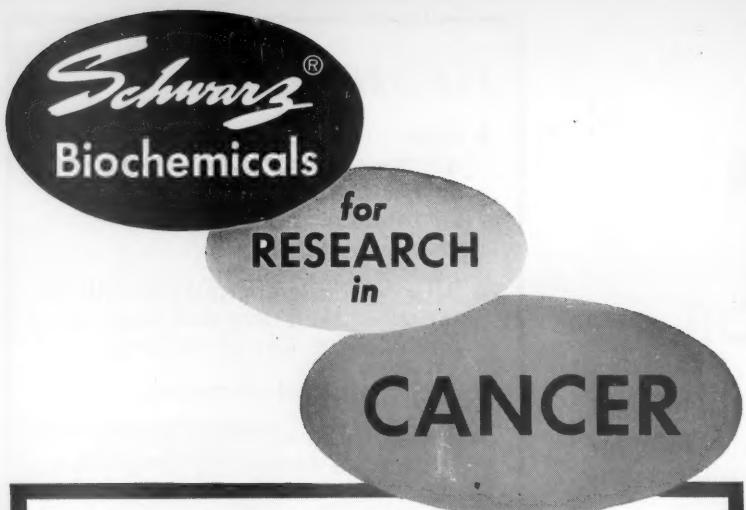
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(Continued from page 1388)

have representation in at least three of those languages; but evidently the principles were relaxed on occasion, and they were ignored for two kinds of words accepted. One consists of numerous "unassimilated guest words, that is, foreign or borrowed words" (Interlingua grammar, Storm Publishers, New York, 1951, section 9). The other consists of "a very liberal supply of grammatical words" (section 134), namely, "all such forms" found in "several older auxiliary-language systems" (Interlingua dictionary, p. xlvi). These systems were doubtless those whose authors had "placed their manuscripts at the disposal of IALA" (Interlingua dictionary, p. xv). Very little is said about Interlingua's grammar, which is mainly that of French without gender and with its individual peculiarities claimed to be removed, with further minor "streamlining" favoring Italian and Spanish—but with irregularities and uncertainties of its own.

The most vital defect of Interlingua is that it cannot be spoken. This is admitted indirectly in the frequent assertion that it can be read with the greatest of ease. In 1951 the above-mentioned IALA circular conceded that "In the early stages of the new language most of its use is likely to be written." The following circuitous words, six years later, seem to admit clearly that its use still has been only written: "For the first time in human history, an international language has been fashioned that can be read at sight by all who can read any Western European language. . . . it [Interlingua] can be considered a sort of basic, average language (primarily for reading), common to most of the reading world. . . . Interlingua can be read without study or preparation by German, French, Italian, Anglo-Saxon, and South American people, as well as by Japanese, Russian, and other people who have been exposed to occidental linguistic patterns" ("Babel resolved," *Science* 126, 55 [1957], editorial by Watson Davis, editor of *Science News Letter*, to whose staff the IALA transferred Gode when it disbanded in 1953). There has not yet been demonstration, report, or claim that anyone can speak Interlingua.

The further unsupported claims quoted in Pei's book that Interlingua is particularly suitable for scientific and technical writing (for which Esperanto is already widely used, in both books and periodicals, including one journal entirely in Esperanto), and also that it is "the" language of scientific congresses because anyone who is "scientifically trained" can read it "with ease" (p. 238), and even that it "is meant primarily for written use at scientific congresses" (p. 171). It impugns the good sense of scientists to propose that they use at congresses a language for reading only, as in

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programs, digests of headphone translations, and "compilation of papers which may be read silently and at leisure" (p. 44). A main purpose of assembly is oral communication and discussion. For such use, Esperanto has proved completely adequate in both its own annual international congresses and in technical and scientific ones.

IVY KELLERMAN REED
315 Westbourne Street,
La Jolla, California

My review of Pei's book did not discuss the comparative merits of Interlingua and Esperanto, for the simple reason that this problem has no bearing on Pei's primary objective. Pei presented a program of "how to achieve one language for the world," leading up to it by (i) a survey of the "linguistic state of the world" and (ii) a summary of past and present interlingual or supralingual events and endeavors. I expressed my doubts regarding the practicability of Pei's program and my unqualified admiration for his preparatory outlines. I supplied no information, inaccurate or accurate, on either Esperanto or Interlingua, but simply reported my impression that of all the available auxiliary-language projects of the "planned or guided" variety, Pei seems to take seriously only Esperanto and Interlingua. This is still my impression; and it is still my impression that "Esperanto emerges," in Pei's book, "as a dream which the faithful believe will come true," while "Interlingua appears as a tool effective today in the specialized applications for which it was designed."

It is obvious that in handling a maze of data of the kind that went into Pei's book, no one—not even a master of organization of Pei's caliber—can avoid every last error of fact or interpretation. I hold that such matters may be given room in a concise review only if they are characteristic of the work reviewed or if they seriously impair its usefulness. Otherwise, I believe, minor inaccuracies had better be drawn to the author's attention privately, for correction in a possible later edition. A point of this kind is Pei's remark (p. 164) that schismatic movements often caused Esperanto congresses to break up in confusion. It has been suggested to Pei that it might be wise to rephrase this passage to avoid all implications of a causal link between congresses and schisms.

I have, on the whole, no comment on Reed's outline of the history of Interlingua. Its peculiar tenor results from Reed's mistaken notion that Interlingua is a "rival system" of Esperanto. It isn't. Esperanto was designed as an autonomous medium, enabling those who have studied it to communicate with one another. To increase its effectiveness, the numbers of its adepts must be increased.

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Reed quotes, disapprovingly, Pei's "quotation" that Interlingua is "the product of the world's greatest linguistic minds over a period of nearly thirty years." She does not claim that I made that statement. She merely says that Pei "imputes" it to me, and goes on to interpret that whoever made it must have meant to refer to Stillman, Martinet, and Gode. Something is a little off here. Actually, no one was referred to, and no one made that statement. Pei dramatized his idea that a world congress should adopt a universal language, outlining in some detail how such a congress might work. For this purpose, he invented some partisan speeches which are amusing to read because they reflect the fun their author had concocting them. It is in one of these that Pei has the spokesman for Interlingua (under my name) claim flamboyantly the endorsement of the world's greatest linguistic minds. There is also some soapbox oratory in support of Esperanto. It never occurred to me, nor, I am sure, to Pei, that anyone could ever try to base a serious argument on these delightful bits of tongue-in-cheek fiction.

ALEXANDER GODE
Science Service, New York

Acknowledgments in Scientific Papers

It seems worth while to bring up a few of the ethical problems which arise in the widely followed practice of making acknowledgments to various persons in scientific papers.

There can, of course, be no quarrel with the specific mention of the source of a culture, of a specimen of known compound, of an intermediate for a synthesis, or of specific analytical data on these preparations, cultures, and so on. Such acknowledgments are essential to the ability of the reader to evaluate the paper, or seek an equivalent starting material, or attempt to repeat and extend the work.

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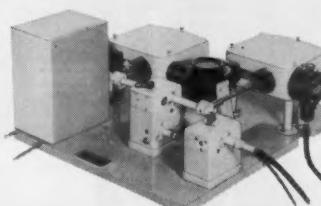


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In my opinion, it not infrequently happens that the individual to whom such thanks are made would prefer not to have his name mentioned in the paper. Frequently his advice was not followed; many times he may object to the conclusions or may not be happy with the data. Often his comments were made casually in discussion, without reference to a specific paper, and he may have no recollection of them. He opens his mail one day to find the latest issue of the journal with the paper in print and with himself as the recipient of the unwanted and unsolicited thanks. He had not been asked or he might well have refused.

Within the past month I requested two individuals who were good enough to send me their manuscripts to delete my name from among such thanks at the end of the manuscripts. In one case my advice, based on about 20 hours of studying the paper and discussing it with the author, was not followed, and I do not believe that the data presented established the validity of the proposed method. In the other case, my contribution was negligible, and the manuscript was sent to me privately for my opinion with a thank-you note already included at the end of the paper. Both manuscripts had been sent to the journal prior to my having seen them. Other persons,

however, have not given me the opportunity of not being thanked!

There is little doubt that the judicious use of such acknowledgments to well-known workers in the field consciously or subconsciously influences referees in the evaluation of the paper. In one instance of which I have firsthand knowledge, a paper refereed was rejected by one journal. The author submitted it to another journal but inserted an acknowledgment to a very prominent worker in the field. After the paper appeared, the person who had refereed it for the second journal asked me for my opinion and, on learning that I did not feel the paper was worth publishing, said that he had refereed it. Really, he said, he didn't know much about the field, but after all, if Professor _____ was given an acknowledgment, the paper must be all right, so naturally he had accepted it. It so happened that Professor _____ had not seen the paper, had not been asked about having his name mentioned, and told me that "he would not have published the paper" on the basis of the data.

Is it too much to expect editors of journals to request that manuscripts containing such acknowledgments be accompanied by a letter from the individual thanked indicating that he has read the paper and has no objection?

ELVIN A. KABAT

Columbia University, New York

Electroconvection

The paper of Dobry and Finn (1) describes a method for the electrophoretic separation of ionic mixtures which has some similarities to that of Philpot (2). It should be a valuable addition to the present list of protein separation methods.

However, the comments of Dobry and Finn on the method of electroconvection are apparently based on a misunderstanding of this method. The fact is that thermal convection currents have no significant effect in the method of electroconvection, since the density gradients established by electrophoretic migration are far greater than those resulting from thermal differences.

The electroconvection apparatus of improved design described by Raymond (3) can in fact be operated at room temperature with no particular necessity for controlling temperature differences within the solution or within the buffer compartments. The heat produced in this apparatus has also been discussed (4). It is true that only one component at a time can be separated by electroconvection, but the actual working time for any given separation is very small. On the other hand, experience with apparatus whose operation depends on a constant and continuous flow of solution

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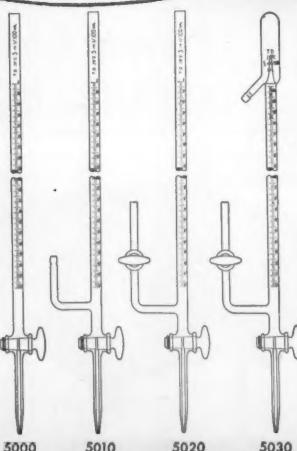
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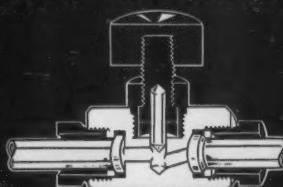
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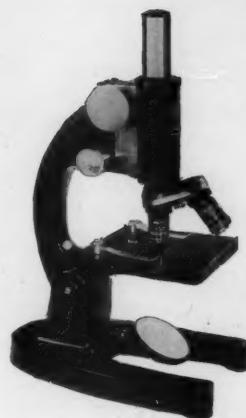
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through the apparatus has demonstrated that many difficulties are encountered in adjusting and maintaining the proper rates of flow.

Dobry very kindly allowed me to see the manuscript of his paper before publication. The points made in this letter were put to him then and should be restated, in order to make clear the usefulness of electroconvection. Production units utilizing this principle have been built on a large scale and work satisfactorily, without any difficulty in heat dissipation.

SAMUEL RAYMOND

University of Pennsylvania Hospital,
Philadelphia

References

1. R. Dobry and R. K. Finn, *Science* 127, 697 (1958).
2. J. S. L. Philpot, *Trans. Faraday Soc.* 36, 38 (1940).
3. S. Raymond, *Proc. Soc. Exptl. Biol. Med.* 81, 278 (1952).
4. ———, *Science* 118, 388 (1953).

We read the comments of Raymond with great interest. Raymond contributed a great deal to the development of electroconvection. One can, therefore, understand his concern at what may appear to be a misrepresentation of this method.

In discussing the matter further, let us differentiate between the principle of the technique as set forth by Kirkwood and his coworkers and the improved apparatus which is available today. Our comments were directed entirely toward the former.

In one of his publications (1) Raymond writes, "At these levels [power inputs of 50 watts and up], also, the cell temperature must be expected to run several degrees above the temperature of the circulating buffer, because of the difficulty of heat transfer through the streamlined currents in the channel." Earlier observation of thermal disturbances was also reported by Nielson and Kirkwood (2). It appeared to us that larger apparatus would have a smaller capacity for heat dissipation—that is, less cooling surface per unit of working space. As a result, liquid would tend to rise in the center of the column, where temperature is at a maximum, and settle near the cooler walls, thus upsetting the laminar convection pattern which is essential for this technique.

It is good to know that Raymond managed to handle this problem successfully in production as well as laboratory units.

REUVEN DOBRY

Pacific Yeast Products, Inc.,
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References

1. S. Raymond, "Electroconvection" (E-G Apparatus Company, New York), p. 39.
2. L. E. Nielson and J. G. Kirkwood, *J. Am. Chem. Soc.* 68, 181 (1946).



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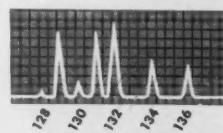
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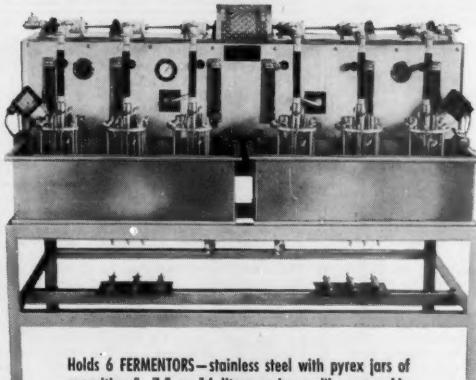


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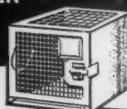
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<input type="checkbox"/> 1369	<input type="checkbox"/> 1370	<input type="checkbox"/> 1371	<input type="checkbox"/> 1372	<input type="checkbox"/> 1373*	<input type="checkbox"/> 1374	<input type="checkbox"/> 1375
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<input type="checkbox"/> 1383	<input type="checkbox"/> 1385	<input type="checkbox"/> 1388*	<input type="checkbox"/> 1389	<input type="checkbox"/> 1390	<input type="checkbox"/> 1392	<input type="checkbox"/> 1439
<input type="checkbox"/> 1440	<input type="checkbox"/> 1441, UI	<input type="checkbox"/> 1441, UO	<input type="checkbox"/> 1441, L*	<input type="checkbox"/> 1442	<input type="checkbox"/> 1443, I*	<input type="checkbox"/> 1443, O
<input type="checkbox"/> 1444	<input type="checkbox"/> 1445, UI	<input type="checkbox"/> 1445, UO	<input type="checkbox"/> 1445, L	<input type="checkbox"/> 1446, O	<input type="checkbox"/> 1446, I*	<input type="checkbox"/> 1447
<input type="checkbox"/> 1448	<input type="checkbox"/> 1449, UI	<input type="checkbox"/> 1449, UO	<input type="checkbox"/> 1449, L	<input type="checkbox"/> 1450, O	<input type="checkbox"/> 1450, UI	<input type="checkbox"/> 1451, U
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<input type="checkbox"/> 1460, LI	<input type="checkbox"/> 1461	<input type="checkbox"/> 1462	<input type="checkbox"/> 1463, UI	<input type="checkbox"/> 1463, UO	<input type="checkbox"/> 1463, L	<input type="checkbox"/> 1464, UO*
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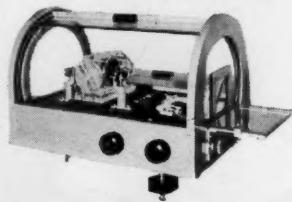
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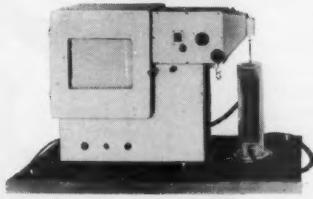
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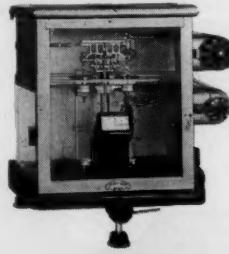
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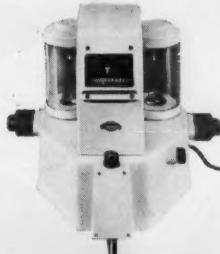
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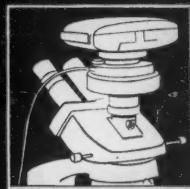
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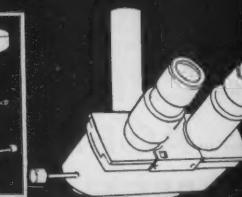
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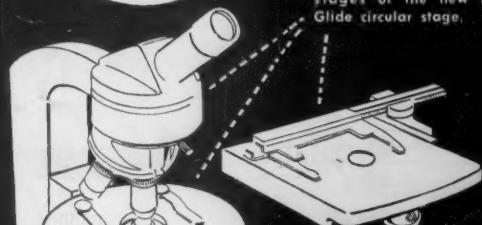
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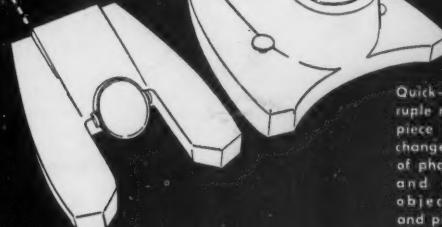
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